DOCUMENT RESUME

ED 303 178 IR 052 628

TITLE	Information Systems for Government and Business: Trends, Issues, Challenges. Proceedings of the Kawasaki International Seminar on the Information Systems Challenge for Government and Business (2nd, Kawasaki City, Japan, July 21-24, 1987).
INSTITUTION	United Nations Centre for Regional Development, Nagoya (Japan).
REPORT NO	ISBN-4-906236-00-6
PUB DATE	88
NOTE	592p.; For the report and summary from this conference, see ED 293 548.
AVAILABLE FROM	United Nations Centre for Regional Development, Nagono 1-47-1, Nakamura-ku, Nagoya 450, Japan ($20.00 for developed countries, $15.00 for developing countries).
PUB TYPE	Collected Works - Conference Proceedings (021) -- Guides - General (050) -- Reports - Research/Technical (143)
EDRS PRICE	MF03 Plus Postage. PC Not Available from EDRS.
DESCRIPTORS	*Business; Case Studies; Developed Nations; Developing Nations; Foreign Countries; Information Networks; *Information Systems; *Information Technology; Management Information Systems; Microcomputers; *Professional Training; *Public Administration; Scientific and Technical Information; Technological Literacy; Telecommunications; *Urban Planning; User Needs (Information)
IDENTIFIERS	Remote Sensing

ABSTRACT

The 25 papers in this proceedings were presented by national and international information systems experts, development planners, and scholars at a seminar that was jointly sponsored by the United Nations Centre for Regional Development and the city of Kawasaki, Japan. Designed to reach a wider group of interested planning practitioners and information systems specialists, the report begins with two keynote addresses: "Information Technology and Regional Development--Challenges and Opportunities for Developing Countries" (Hidehiko Sazanami); and "Public/Private Partnerships in Information Systems in Public Administration" (Jean V. Salmona). The texts of 22 papers are then presented in five categories: (1) The Challenges of Information Systems Today; (2) Comparative Case Studies of Information Systems Projects; (3) Training in Information Systems; (4) Developing and Implementing Effective Information Systems Strategies; and (5) The Advanced Information City. A synthesis of the findings of research on information systems implementation in developing countries concludes the report. Countries represented in the individual presentations include China, Indonesia, Japan, the Netherlands, Singapore, and Thailand. Introductory materials include an annotated listing of the presented papers, and a list of contributors which includes their addresses is attached. (CGD)

ED303178

INFORMATION SYSTEMS FOR GOVERNMENT AND BUSINESS

Trends, Issues, Challenges

U.S. DEPARTMENT OF EDUCATION
Office of Educational Research and Improvement
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

☑ This document has been reproduced as received from the person or organization originating it

☐ Minor changes have been made to improve reproduction quality

- Points of view or opinions stated in this document do not necessarily represent official OERI position or policy

"PERMISSION TO REPRODUCE THIS MATERIAL IN MICROFICHE ONLY HAS BEEN GRANTED BY

Josefa S. Edralin

TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)."

IR052628

INFORMATION SYSTEMS FOR GOVERNMENT AND BUSINESS

OTHER UNCRD PUBLICATIONS ON INFORMATION SYSTEMS

Book

Information Systems for Urban and Regional Planning: Asian and Pacific Perspectives. (1986)

Periodical

"Training in Information Systems for Local and Regional Planning" Topical theme of *Regional Development Dialogue*, vol. 8, no. 1, Spring 1987.

Meeting Reports

"Information Systems for Urban and Regional Planning: Their Use and Application in Developed and Developing Countries." Report and Summary of Proceedings of the Kawasaki International Seminar on Information Systems for Urban and Regional Planning, Kawasaki City, 3-6 October 1984. (Meeting report series; no. 13).

"Training in Information Systems for Local and Regional Planning." Report and Summary of Proceedings of the UNCRD Expert Group Meeting on Training in Information Systems for Local and Regional Planning in Developing Countries, Nagoya, 16-19 June 1986. (Meeting report series; no. 18).

"Information Systems for Government and Business: Challenges and Opportunities." Report and Summary of Proceedings of the Second Kawasaki International Seminar on the Information Systems Challenge for Government and Business, Kawasaki City, 21-24 July 1987. (Meeting report series; no. 23).

Working Papers

Belarmino, Isagani C., "Information Systems for Regional Planning in the Philippines." (1984) (Working paper; no. 84-1).

Morita, Sozo, "Information Systems for Regional Development and Planning in Aichi Prefecture, Japan." (1986) (Working paper; no. 85-3).

INFORMATION SYSTEMS FOR GOVERNMENT AND BUSINESS

Trends, Issues, Challenges

United Nations Centre for Regional Development, Nagoya Japan

© 1988 by the United Nations Centre for Regional Development

ISBN 4-906236-00-6

Opinions expressed in various sections of this volume are those of the authors and do not necessarily reflect those of the United Nations Secretariat, the United Nations Centre for Regional Development, or the Kawasaki City Government.

Designations employed and presentation of material in this publication do not imply the expression of any opinion whatsoever on the part of the United Nations Secretariat, the United Nations Centre for Regional Development, or the Kawasaki City Government concerning legal status of any country or territory, city or area, or of its authorities, or concerning the delimitation of its frontiers or boundaries.

FOREWORD

The publication of *Information Systems for Government and Business: Trends, Issues, Challenges* is another indication of the commitment made by the United Nations Centre for Regional Development (UNCRD) to pursue the Research Project on Information Systems for Local/Regional Development under its Information Systems Unit. Given UNCRD's mission to enhance the capabilities of the developing countries in local/regional development planning, it is important that there is an ongoing effort pertinent to information systems.

This publication grew out of a seminar jointly sponsored by the UNCRD and the Kawasaki City Government. The Second Kawasaki International Seminar on the Information Systems Challenge for Government and Business was held in Kawasaki City on 21-24 July 1987 and brought together national and international information systems experts, development planners, and scholars, some of whose papers are presented in the ensuing pages.

The papers presented at the seminar were well received and interest was expressed on dissemination of the papers through a publication.

We hope, through this publication, to reach a wider group of interested planning practitioners and information systems specialists, who would not only benefit from the papers but also be encouraged to pursue further the issues identified in efforts to develop and implement information systems projects. Additionally, the publication helps to meet a gap, in that currently there is scant material on comparative case studies and on training and research in information systems in the developing countries.

We trust this publication will be a useful information resource for those with interest in information systems development strategies. The organizational, sociopolitical, and human resource issues discussed in the book need to be explored further. There is need for further research in information systems in an interdisciplinary context. In a real sense the key to improving decision making and planning lies in the decision makers' and planners' recognition of the value of information in such activities.

This work was made possible by the collaboration of the participants of the seminar and the supportive environment of the Kawasaki City Government. Most of all we are grateful to Arporn Chanchareonsook, Christian P. Averous, Michael Batty, Peter Droege, Romeo H. Gecolea, Sukehiro Gotoh, Hideki Kaji, Hidemitsu

FOREWORD

Kawakami, Richard E. Klosterman, Ko Kheng Hwa, Frank le Clercq, Gerard Linden, John Lindsay, Marvin L. Manheim, John B. Rose, Jean V. Salmona, K. V. Sundaram, Suroso Moersidi, Itoko Suzuki, Moriaki Tsuchiya, Sidney S. Witiuk, and Yu Hong.

We also wish to acknowledge the cooperation of other seminar participants who are not represented by papers in this volume. We are grateful for their participation in the seminar.

The editorial assistance of Aminta Lara-Peters and James F. Goater, and the secretarial assistance of Sachiko Sasaki and Milagros Formoso is gratefully acknowledged. J. S. Edralin, UNCRD Information Systems Planner and Coordinator of the Information Systems Research Project, edited the final manuscript for publication.

We wish to acknowledge a special debt of gratitude to the Kawasaki City Government for cosponsoring the seminar.

H. Sazanami

1 June 1988

Hidehiko Sazanami
Director, UNCRD

ABOUT THE BOOK

PART I: THE CHALLENGE OF INFORMATION SYSTEMS TODAY

Chapter 1, "Using Information Systems to Compete Successfully in Today's World: A Challenge to Managers," by Marvin L. Manheim, emphasizes the following points:

(a) Information systems and telecommunications (IST) is a strategic weapon;

(b) To be effective, technology change must be planned and managed as people change;

(c) Systematic methods are available for managers to use to develop an IST-based strategy and implementation plan;

(d) The most effective training programme will be one that is designed to support the IST-based strategy of the organization.

In the author's view, to be fully effective, a training programme must be designed, not simply as a set of lessons in the techniques of a technology, but as a major component of senior management's strategy for achieving the basic goals of the organization.

Moving beyond these points, the author identifies some key issues for managers and for research.

Chapter 2, "Microcomputer Technology and Regional Planning: Prospects and Challenges for the Developing World," by Richard E. Klosterman, examines the role which microcomputers can play in third world regional development planning. Four features make microcomputers particularly well suited for use in the developing world: They are easy to maintain, easy to use, highly adaptable, and relatively cheap. Nevertheless, fundamental obstacles must be overcome in implementing microcomputer-based planning tools. Microcomputer hardware and software are scarce and trained computer personnel are extremely difficult to find -- and retain -- in the public sector. Adequate theories and reliable and consistent information are often unavailable.

The paper examines the appropriateness of eight microcomputer applications for third-world planning: Planning software, electronic spreadsheets, data base management, statistical analysis and forecasting, thematic mapping, computer-aided design and drafting (CADD), geographic information systems (GIS), and expert systems.

Chapter 3, "Theory of the Urban Environmental Master Plan for Kawasaki City and the Development Guiding Principle for the Supporting Planning Information System," by Hidemitsu Kawakami, briefly discusses the supporting information system for the master plan -- its functions and requirements, and the range of data processing envisaged. The computer information system provides real-time access to information on the current state of the environment, as well as support for the analysis and evaluation of the information generated.

Chapter 4, "Changing Data and Information Needs for Agricultural Planning: The Challenge for the Developing Countries," by K. V. Sundaram, takes a planner's perspective on information systems and their role in multilevel planning. The change in planning orientation from a growth-oriented paradigm to one based on redistribution with growth, as well as the change in the structure of planning from centralization to decentralization, will redefine the data and information requirements for planning. The author suggests an approach to produce a coherent information strategy: (a) identify multilevel data and information needs; (b) institute adequate project-level data collection arrangements; (c) ensure that information structures match authority structures; (d) set up appropriate network of microcomputers linked to a central mainframe computer; (e) a modular and staged approach taking into account various constraints of developing countries; and (f) devise suitable training programmes for relevant personnel.

PART II: COMPARATIVE CASE STUDIES OF INFORMATION SYSTEMS PROJECTS

Chapter 5, "'INFOTERRA': A Global Environmental Information Network," by Sukehiro Gotoh, describes an information referral system that the United Nations Environment Programme (UNEP) has developed. The system centres around government designated focal points in 127 countries. These national focal points select expert institutions within their countries to serve as information sources. In addition to national users, the system also serves the international community. As the quality of information provided determines the credibility of INFOTERRA, quality control is exercised in the selection of information sources, based on user satisfaction studies.

Chapter 6, "Promoting Spatially-Oriented Referencing Systems Development at the International Level," by Sidney W. Witiuk, describes the role of the Spatially-Oriented Referencing Systems Association (SORSA) in promoting the development and use of such system in developing and developed countries. Common applications include: (a) computer mapping and cartography; (b) urban and rural planning; (c) emergency service dispatch; (d) districting; (e) allocation/distribution modeling; (f) routing/navigation; (g) address or postal code geocoding; (h) environmental inventory and impact studies; and (i) utility network modeling.

Chapter 7, "Information Systems Project for Urban and Regional Planning in China," by Yu Hong, presents an overview of four information systems -- the Urban Construction and Management Data Base System; the Urban Traffic Information System; the Urban Planning and Management System of Huhehot City; and the Urban and Rural Construction Information Retrieval System (URCIRS). Yu focuses on URCIRS, which contains three data bases (i.e., bibliographic, Chinese patents management, and scientific-technical personnel management data bases).

Chapter 8, "Information System Project for Urban Planning at the Bangkok Metropolitan Administration," by Arporn Chanchareonsook, examines the potential of computer information systems to improve urban planning and monitoring. The author reviews and describes the results of five foreign-assisted pilot studies undertaken in Bangkok to develop land information systems. She then makes a case for the gradual introduction and adoption of computer land information systems.

Chapter 9, "Remote Sensing System and Digital Processing for Regional and Urban Monitoring in Indonesia," by Suroso Moersidi, describes the significance of an integrated management information system (MIS) to spatial and agricultural planning and decision making. The author presents two case studies which show how MIS is used for agricultural land evaluation and for monitoring land use changes in urban areas. In the last part of his paper the author assesses the factors which inhibit the project's success and the areas where improvements are needed (i.e., project organization and management, technological know-how, technology development, and international cooperation).

Chapter 10, "Evaluating the State of Information Systems in Amsterdam," by Frank le Clercq, reviews and describes three sectoral information systems projects of the Physical Planning Department -- the Population Forecasting, Transportation Planning, and Building-Use Information Systems. The author uses a model for assessing the contribution of the projects to the management knowledge system.

Chapter 11, "Information Processing System for Disaster Management," by Hideki Kaji, briefly outlines the information requirements for four stages of disaster management. Phase I, Pre-disaster is concerned with data base creation, casualty and damage prediction, training for citizen awareness and preparedness, and early signs of impending earthquake. Phase II, Warning, covers broadcast alert, directives, and tidal wave and earthquake information. Phase III, Emergency countermeasures, includes damage and casualty information, fire-outbreak spots, conflagration status reports, evacuation route, population by zone, available hardware, materials, and personnel, demand, rescue, and first-aid. Phase IV, Recovery and reconstruction, requires information on total damage incurred, who is doing what and where, progress of rescue and first-aid efforts, and recovery and reconstruction plans.

PART III: TRAINING IN INFORMATION SYSTEMS

Chapter 12, "Problems of Implementation of and Training in Information Systems for Subnational Development Planning," by Ralph Adam and John B. Rose, briefly discusses the common information needs of planners at the regional, urban, and local/rural levels and shows the importance of geographic (spatially referenced) information in this context. The various components of relevant information systems and the different approaches to implementation are reviewed, with emphasis on software and on problems in training users and developing specialized manpower.

Some plans and experiences in information systems development and training for subnational planning are presented with emphasis on the activities of the United Nations Educational, Scientific and Cultural Organization (UNESCO) at the international and regional levels and those of the Institute for Offshore and Coastal Research (INCOR) in India at the national level. A number of recommendations on the training of information specialist and users and on the dissemination of experience among and to the developing countries are put forward.

Chapter 13, "Educating Planners in Information Technology: Experiences from Developed and Developing Countries," by Michael Batty, presents a broad ranging review of the role of information technology in urban and regional planning, emphasizing the critical issues involved in training and educating planners in the new skills required. The main theme developed concerns the ubiquity and diversity of information technology in society in general and planning in particular, and the need to develop appropriate responses in specific situations. A model of the planning task environment and the way in which information technology is and can be applied is outlined. Possibilities and challenges for education and training emerge from this, but present responses appear somewhat muted, at least in British planning practice. It is argued that the speed of the transition to the information society and the "shock" of being introduced to so many new opportunities involving information processing is as great in the developed as in developing countries. This is illustrated in the author's own working environment in terms of the way hardware and software have changed over the last decade. The difficulties of making use of these new opportunities are then discussed using case studies involving students from developing countries which the author is acquainted with. It is then argued that the basic task of training and education in this field is to provide planners with opportunities and skills in creatively handling and adapting standard software for specific planning tasks, not in becoming "aware" *per se* or in learning analytical-programming skills. The challenge then is in providing methods which enable planners to blend their general knowledge of hardware and software opportunities with their specific knowledge of planning tasks and organizational structures.

Chapter 14, "The Development of Curricula in the Field of Geo-Information Systems: The ITC Experience," by Gerard Linden, addresses the problem of curriculum development in the field of geo-information systems (GIS) with examples from the experience of the International Institute for Aerospace Survey and Earth Sciences (ITC). There are three main parts. Part one introduces the field of GIS. The idea is to present a bird's-eye view of the area and adhering issues of relevance to curriculum development. The fundamental role of surveying and geo-information in development is elaborated as are target groups according to function. Part two is on ITC as an educational institute, its role in development, and the present regular GIS diploma courses. Part three discusses the guiding principles for future curricula. Geomatics is introduced as a guiding principle. An example of a recently developed course on integrated digital map and information production is given. The paper concludes with a discussion on problems relating to curriculum development in the field of GIS.

Chapter 15, "Training for Information Resources Management in Public Administration: UN/DTCD's Case," by J. M. Oyugi and Itoko Suzuki, describes the organization strategy and training methods for a modular executive development programme developed by the United Nations Department of Technical Co-operation for Development (UN/DTCD). The programme could serve as a sensitization programme for promoting the use of information technology among senior government officials in developing countries. The curriculum includes knowledge on laws and regulations on government information systems, and on procurement and contracting. It also includes skills in application and development as well as basic computer literacy training.

PART IV: DEVELOPING AND IMPLEMENTING EFFECTIVE INFORMATION SYSTEMS STRATEGIES

Chapter 16, "Information Systems for Rural Development," by Romeo H. Gecolea, identifies and analyses selected information issues which should be of concern to project implementation (e.g., lack of appreciation of information systems as management tools, poor human and physical infrastructure, and limited budgets). The author suggests some guidelines in designing information systems and concludes that crucial design tasks lie at the points before and after data are processed, i.e., educating users on the value of information systems, selecting useful parameters to ensure the collection of valid and reliable data, and creating mechanisms for information utilization.

Chapter 17, "Development Strategies Concerning Information Systems in Urban and Regional Planning," by Christian P. Averous, assesses the context for the introduction of information systems into urban and regional planning (e.g., increasing demand for information, changing telecommunication and computer technologies, changing urban and regional policy priority issues, and economic constraints on employment and public spending). The use of information systems by local governments follows two strategies: (a) computerization of administrative tasks and information support for decision making; and (b) contribution of the information sector to urban and regional development. The constraints to information systems development are becoming less technical or financial and are increasingly related to proper training and more effective organization. Implementation issues relate to the cost/benefit analysis of the investment in information systems, progressive implementation, assistance and maintenance, privacy protection, and the technical quality of data.

Chapter 18, "Designing and Implementing Information Systems Strategies," by John Lindsay, outlines some of the approaches to designing information systems, while noting that these have generally developed in the private sector and are therefore constrained by a substantial concentration on the issue of profit drive. These approaches might be summarized as:

(a) Identification of broad strategic requirements;

(b) Identification of the critical success factors;

(c) Identification of the decisions which have to be taken;

(d) Identification of the people who make these decisions;

(e) Identification of the information they require; and

(f) Identification of the operations from which this information is derived.

Some of the factors involved in a successful design include: Highest level commitment; organizational backing; and a clear review procedure.

The author indicates some of the particular issues involved in the context of developing countries. These include questions of appropriateness, aid funding, project management, and the concept of "developing" itself. Attention is drawn to the limitations of the experience of aid funded projects so far.

The author concludes that the strategies for designing information systems in general are useful, but that the key is motivated individuals who are prepared to start at any point and think big, but start small.

Chapter 19, "Strategies for Developing and Implementing Information Systems in Public Administration: From Classical Informatics to New Information Technologies," by Jean V. Salmona, addresses the major issues in the use of information systems in public administration: (a) standards setting, including network, data, and software standards; (b) information systems design and implementation requirements in an organization, including methodologies, organizational structures, and information resource management. Increased user awareness, user training, and providing users with a choice of hardware and application software, as well as an opportunity to develop their own application software, are practical ways of developing and implementing information systems.

Chapter 20, "Effective Information Systems Strategies for the Government Service: The Singapore Experience," by Ko Kheng Hwa, reviews the Civil Service Computerization Programme strategy and the problems faced in early stages of the programme. The keys to the strategy are total commitment from the government to computerize its operations and strong pressure on government departments to improve productivity and upgrade the level of public service. The author outlines seven strategies followed in the implementation of the programme: Balance between centralization and decentralization, partnership philosophy, management commitment, strategic information systems planning, user education, framework for data sharing, and moving up the experience curve. The progress made in achieving the objectives of the computerization programme, the number of application systems completed, attendance at user education programmes, the development of internal capacity within the civil service, and the building up of technological base and infrastructure to exploit and manage information technology, underline the effectiveness of the strategies adopted.

Chapter 21, "Strategic Use of Information Systems among Japanese Private Corporations," by Moriaki Tsuchiya, contends that information systems are assuming a strategic importance for many companies in Japan, enabling them to maintain or gain competitive advantage. The impact of information systems on business is becoming widespread (e.g., automated production systems, automatic telling machines, point-of-sale systems, use of personal computers to coordinate intracompany functional activities, value-added networking, and voluntary networking systems).

PART V: THE ADVANCED INFORMATION CITY

Chapter 22, "Technology for People: A Campus City Guide," by Peter Droege and his team, is the final proposal of the contestant to the International Concept Design Competition for an Advanced Information City, held in 1987 in Kawasaki City, Japan. The open city concept has three different, but inseparable components: (a) The Kawasaki Institute of Technology (KIT); (b) Intelligent Places; and (c) The City of Festivals. The idea of a broad citywide education is at the base of the campus city concept. KIT and the campus city need the active participation of the citizens. By looking for ways to place technology in the hands of the citizens, the campus city may become an international model for rebuilding future cities.

SYNTHESIS OF RESEARCH FINDINGS

"Hopeful Beginnings: A Study of Information Systems Implementation in Developing Countries," by J. S. Edralin, provides a brief synthesis of the findings of Phase III of the UNCRD Research Project on Information Systems for Local/Regional Development. It provides an overview of the information systems project implementation experiences in China, Indonesia, and Thailand -- including institutional support, services provided, achievements, problems, and lessons learned from the information systems projects.

CONTENTS

Foreword v

About the Book vii

Tables xix

Figures xxi

Keynote Speeches

Information Technology and Regional Development: Challenges and Opportunities for Developing Countries
Hidehiko Sazanami 3

Public/Private Partnerships in Information Systems in Public Administration
Jean V. Salmona 9

Part I: The Challenge of Information Systems Today

1 Using Information Systems to Compete Successfully in Today's World: A Challenge to Managers
Marvin L. Manheim 15

2 Microcomputer Technology and Regional Planning: Prospects and Challenges for the Developing World
Richard E. Klosterman 77

3 Theory of the Urban Environmental Master Plan for Kawasaki City and the Development Guiding Principle for the Supporting Planning Information System
Hidemitsu Kawakami 95

4 Changing Data and Information Needs for Agricultural Planning: The Challenge for the Developing Countries
K. V. Sundaram 105

CONTENTS

Part II: Comparative Case Studies of Information Systems Projects

5 "INFOTERRA": A Global Environmental Information Network
Sukehiro Gotoh 151

6 Promoting Spatially-Oriented Referencing Systems Development at the International Level
Sidney W. Witiuk 163

7 Information Systems Project for Urban and Regional Planning in China
Yu Hong 171

8 Information System Project for Urban Planning at the Bangkok Metropolitan Administration
Arporn Chanchareonsook 187

9 Remote Sensing System and Digital Processing for Regional Planning and Urban Monitoring in Indonesia
Suroso Moersidi 201

10 Evaluating the State of Information Systems in Amsterdam
Frank le Clercq 241

11 Information Processing System for Disaster Management
Hideki Kaji 269

Part III: Training in Information Systems

12 Problems of Implementation of and Training in Information Systems for Subnational Development Planning
Ralph Adam and John B. Rose 287

13 Educating Planners in Information Technology: Experiences from Developed and Developing Countries
Michael Batty 317

14 The Development of Curricula in the Field of Geo-Information Systems: The ITC Experience
Gerard Linden 363

15 Training for Information Resources Management in Public Administration: UN/DTCD's Case
J. H. Oyugi and Itoko Suzuki 389

Part IV: Developing and Implementing Effective Information Systems Strategies

16 Information Systems for Rural Development
Romeo H. Gecolea 423

17 Development Strategies Concerning Information Systems in Urban and Regional Planning
Christian P. Averous 433

18 Designing and Implementing Information Systems Strategies
John Lindsay 459

19 Strategies for Developing and Implementing Information Systems in Public Administration: From Classical Informatics to New Information Technologies
Jean V. Salmona 493

20 Effective Information Systems Strategies for the Government Service: The Singapore Experience
Ko Kheng Hwa 505

21 Strategic Use of Information Systems among Japanese Private Corporations
Moriaki Tsuchiya 517

Part V: The Advanced Information City

22 Technology for People: A Campus City Guide
Peter Droege and Team 525

Synthesis of Research Findings

Hopeful Beginnings: A Study of Information Systems Implementation in Developing Countries
J. S. Edralin 575

Contributors 585

TABLES

3.1 Basic data stocked by the agency 98

4.1 Planning stages, phases, and information requirements 116

4.2 Planning functions at different hierarchical levels (illustrative) 119

4.3 Data and information needs at multilevels 122

9.1 Population projection of Indonesia, 1980-2000 (in millions of people) 205

9.2 Projection of rice milled and rice paddy size 206

9.3 Budget allocations for remote sensing project 208

9.4 Technology transfer condition of counterparts 213

9.5 Evaluation of personnel ability in using hardware system 214

9.6 Example of grid-cell size 224

9.7 Result of land evaluation for Java, Madura, and Bali islands using "pattern" method (km^2) 235

9.8 Selected urban population growth prospects 237

11.1 Information required for disaster management 270

13.1 Typical software usage by British local planning authorities 334

14.1 Three levels of staff and their functions 371

14.2 The subjects of the first GIS cadastral course in October 1985 373

FIGURES

1 Basic information technology options 33

2 Information technology options - expanded set 34

3 Porter's value chain 37

4 Major actors and external linkages 38

5 Wiseman's strategic options matrix 40

6 Product-market segment matrix 42

7 Linking strategy to people 43

8 Translating strategy into action 44

9 Integrated action programme 46

10 Typical strategic planning process 54

11 Planning process with IST emphasis 54

12 The system of urban environmental master planning 97

13 Schematic diagram of structure and orientation of development planning 106

14 A hypothetical multilevel planning system showing levels, flows, and interaction 118

15 Policy areas and information relevant to improved food and nutrition 124

16 A multilevel planning system 128

17 The "INFOTERRA" referral scheme 154

18 Global geographical distribution of countries and NFPs 157

19 Annual growth in number of national focal points 158

20 Annual growth in total number of inquiries per year .. 159

21 "INFOTERRA" structure and its information flowchart .. 160

FIGURES

22 Mapping preparation: the manual tax mapping project work flowchart 194

23 Compilation of information and tax mapping preparation: the manual tax mapping project work flowchart 195

24 Data base profile 209

25 Basic concepts of the system 210

26 Concept and basic framework of evaluation mapping using a landscape model data base 211

27 A representation of spatially-oriented information system 217

28 Future development of R/S project 219

29 Hardware configuration 221

30 Hardware configuration of NEC Personal Computer 9801 VM 222

31 Software coverage on PRESS system 223

32 Index grid-zone area size 6 x 8 225

33 National base map (scale 1:100,000) 226

34 A simple example of integrated analysis of spatial data (concept) 227

35 Block diagram of image classification 229

36 The management of data 230

37 Combination data from data base for land evaluation .. 232

38 Evaluation process 234

39 Population development in successive city extensions 243

40 Substitution of data and knowledge 251

41 Information acquisition matrix and elementary planning support tools 258

42 Network of problem-working states and choices 260

FIGURES

43 The position of a management knowledge base 262

44 Radio communications system for disaster management at city-level 274

45 Related bodies on a real-time basis evacuation control system (within broken line) 275

46 Real-time information processing system 276

47 Algorithm of fire spread RTS model 278

48 Transition of equation adopted as ROS 279

49 An example of the output of the fire spread RTS model 280

50 Assignment of width of roadway 281

51 The latest departure time given in graph form 281

52 The latest departure time 282

53 Suggested schedule: seminar for system administrators 295

54 Components of a software package for subnational planning 298

55 The cyclic planning process 326

56 The sequence of tasks in the planning process 327

57 Information activities and systems in the planning process 328

58 Hardware in the Department of Town Planning, UWIST, in mid-1979 343

59 Hardware in mid-1980 344

60 Hardware in the Department of Town Planning, UWIST, in mid-1983 345

61 The present (mid-1987) configuration of hardware in the Department of Town Planning, UWIST 347

62 Information technology and the local area network in UWIST mid-1987 348

FIGURES

63 Software types concatenated with user roles 353

64 Geographical data processing model 367

65 Framework of the ITC course and its linkage with other courses 381

66 Number of subscribers 435

67 The Garonne Basin 439

68 Scheme of the "Minitel" system 443

69 Landsat 5 satellite 449

70 Spot satellite 450

71 Organizational value chain and cost drivers 485

72 KIT curriculum 532

73 Transportation system 541

74 Smart boxes 545

75 Intelligent gardens 548

76 The river project 550

77 Metro plaza 551

78 Kawasaki's internal festival system 557

79 Intelligent plazas 562

80 Campus area network 563

KEYNOTE SPEECHES

INFORMATION TECHNOLOGY AND REGIONAL DEVELOPMENT: CHALLENGES AND OPPORTUNITIES FOR DEVELOPING COUNTRIES

Hidehiko Sazanami

First of all, I would like to extend a very cordial welcome to you all. It is a pleasure to know that you have accepted our invitation to take part in this seminar, despite traveling distances and pressure of work at home. Your presence here reflects your interest in the seminar.

On introducing the seminar's theme "Challenges Facing Managers and Officials in Business and in Urban and Regional Planning in Developing and Developed Countries," it is recognized that the topic is appropriate and timely to the seminar organizers, the United Nations Centre for Regional Development (UNCRD), and the Kawasaki City Government because they have in the last few years been undertaking a research project on information systems for regional planning and an international concept design competition for an advanced information city, respectively. The seminar will therefore provide an opportunity to expose this body of work for review by an international audience and to exchange views and experiences on the subject.

The UNCRD, which aims to create and strengthen capabilities for local and regional planning and management in the developing countries of Asia and the Pacific, Africa, and Latin America and the Caribbean, is currently concluding Phase III of its research project on information systems for regional planning. This phase of the research project aims to review selected information systems projects and training programmes in computer-assisted regional planning, and identify concrete factors within each project or programme that help or hamper the achievement of its objectives. The research results will be presented in this seminar.

Information systems constitute an important and often ignored and unexploited resource for regional development -- especially in developing countries. The benefits likely to result from the development and implementation of information systems can be cited:

- Improved effectiveness and efficiency of planning activities in the region.
- Improved capability to understand the region's economic situation and assess its economic strengths and weaknesses.
- Wider knowledge base for the identification of development alternatives and selection of strategies for regional development.
- Improved monitoring of the implementation process and evaluation of regional development programmes and projects.

Applied to these ends, information systems and information technology can make an important contribution to regional development objectives by:

- Contributing to economic development and growth in the region by creating new markets, generating investment, income, and new jobs, revitalizing industries, improving production processes and products, and promoting greater mobility in capital and financial flows and services.
- Facilitating a continual two-way flow of information between and among the local development planning units and the national development planning units.
- Facilitating interpersonal communications for people in remote areas and between people in urban and rural areas.

The pervasive role of information technology in regional development is increasingly recognized by those concerned with the development process worldwide. From a survey of the literature and evolutionary trends in developed countries it seems that information technology could have a strong impact on the economic development of peripheral regions. In the last ten to twenty years, several regions of the United States, Canada, and the United Kingdom, for example, have developed strong local economies based on high-technology industries. Competition between regions to attract high-technology industries has been responsible for public and private sector programmes to promote high-technology development. In these countries, local or state government programmes usually involved the participation of universities, local governments, and/or private sectors, while national government programmes have encouraged pilot studies and provided planning grants, advice and technical assistance, and development funds. Some of the programmes were geared at promoting greater interaction between universities and the private sector through the creation of research and science parks, research centres, and technical extension services. In addition, national and state policies have provided the stimulus for the increased high-technology activities at the state and local levels.

Concurrently, recent research studies in developed countries have explored the regional impacts of technical change, within the wider contexts of industrial restructuring processes. The research studies addressed such popular themes as: Industrial restructuring and the internationalization of production, the role of technical change in national and regional economic development, the actual effect of new technology on firms and labour, and the role of small firms in regional development.

The question of the regional impact of information technology is very relevant to developing countries, and it is highly related to the question of their capability and resources, both human and financial, to acquire and put to use such technology. The developing countries differ in their technological capabilities. They are generally deficient in information infrastructure, including information resources, trained information specialists and systems personnel, and communications facilities. The capabilities in those countries for acquiring, organizing, processing, analysing, and disseminating information are also limited. These deficiencies result in inadequate information for regional development, inability to use effectively the available information, and limited flow of information generated by local and regional development agencies in developing countries.

Furthermore, the introduction of information systems and information technology in selected regions of developing countries presents difficulties because of the following reasons:

- The concept is relatively new in most developing countries.
- There is lack of governmental policies in the development of information systems and information technology in developing countries.
- There is lack of technological know-how and technical skills, and there is mass illiteracy in some developing countries. This situation will leave the local and regional offices hard-pressed for qualified technical and skilled workers.
- There is perhaps too much emphasis on high technology while most of the developing countries probably need

simple and more flexible technology. Therefore it is essential to integrate the new technologies with old, viable, or salvageable technologies.

. In spite of a probable shift of employment from the manufacturing to the service sector, the employment-displacing effects of technological change in developing countries will be more predictable than its job-creating effects. It is feared that there might be massive lay-offs of assembly line and clerical workers in the conversion from manually-operated to computer-driven factories and offices. Jobs are needed in developing countries where unemployment is high and there is no welfare system.

. The high cost of information technology, lack of financial capability, and government-imposed currency and import restrictions or controls make it hard for developing countries to acquire computer hardware, software, and spare parts. These control measures prevent developing countries from acquiring information technology at reasonable cost. Unless developing countries can obtain external financial assistance or become self-reliant, they will have to rely on a cheaper technology. That would probably mean a lower quality of equipment and information product or output, and limited applications of information technology.

Thus, the challenge of attracting information technology in the regions of developing countries will be tougher than ever. Other barriers to the transfer of technology to developing countries are the cultural attitudes and values, the poor telephone, communication, and transportation services, high power costs and power shortage, labour unrest, red tape, pilferage, materialism and corruption, and the absence of auxiliary industries.

Policy guidelines are therefore needed to guide the development of information systems and information technology in developing countries -- guidelines that identify the capabilities of developing countries that need to be developed or strengthened to enable them to acquire and use information technology more effectively, identify the weak points in the existing system, provide guidance for the development and implementation of information systems, and provide the basis for formulating programmes and projects that would have maximum impact.

This seminar is an important step towards meeting this need for guidelines. It will be an opportunity to reflect upon the needs and challenges in developing and implementing information systems for regional development. It will also be a chance to consider the technological changes and innovations, as well as new opportunities for public and private information systems in the years ahead.

The seminar brings all sectors (public and private sectors, and developing and developed countries) together to learn from one another and identify the lessons learned that will be of relevance to other organizations in the process of developing their information systems, evaluating their existing systems, assessing their future requirements, and proposing the development of an information system strategy.

Twenty-four international experts and practitioners from relevant organizations, universities, information systems associations, national and local governments, and business organizations are participating in the seminar. Representatives from Japanese academic, planning, and research institutions are also participating. The experience of Australia, Canada, China, France, Indonesia, Italy, Japan, Malaysia, Netherlands, Saudi Arabia, Singapore, Thailand, United Kingdom, and the United States, as well as the experience of some United Nations organizations will be presented.

The participants will play key roles by presenting resource papers and case studies on the themes of the seminar and by making commentaries on the papers and case studies. All of the sessions are of very high quality and should provide opportunities for learning and discussion. As organizers and sponsors of this seminar we hope that it will make a further contribution towards the appreciation and critical understanding of planning information systems in the developing and developed countries' contexts.

In closing, I would like to thank Mayor Saburo Ito and the officials and staff of Kawasaki City who have so willingly given their full support and cooperation in sponsoring and organizing this seminar. I would also like to thank the officials of the World Health Organization, the Data for Development International Association, the Spatially-Oriented Referencing Systems Association, the Ministry of International Trade and Industry, the Ministry of Posts and Telecommunications, the Ministry of Construction, and the National Land Agency of the Government of Japan for their moral support in cosponsoring this seminar and participating in the deliberations.

Thank you.

PUBLIC/PRIVATE PARTNERSHIPS IN INFORMATION SYSTEMS IN PUBLIC ADMINISTRATION

Jean V. Salmona

In the use of information technologies (IT), and specially in the design, development, and management of information systems, public administration is facing many problems. Among these, we shall mention that it is impossible to recruit and keep good IT specialists, at least in most countries, due to the level of remuneration in public administration; that it is not within the culture and competence of public administration in general to manage information systems projects; and maybe the most important, that public administration is not able to review and change itself (in spite of many attempts to organize administrative reform, in most countries public administration has changed very little during the past century, compared to the changes which have occurred in the business sector).

What happened in public administration is that information technologies have developed without significant changes in organizational structures and procedures. Moreover, new departmental units for information technologies are themselves, in many cases, a constraint to change, as they have established new powers, which they want to keep. More generally, information technologies have not penetrated the day-to-day life of public administration; therefore, they cannot be expected to increase productivity if the situation is not changed in a drastic way.

In the business sector (generally private, maybe public in some countries), the same constraints and limits do not exist. Besides, businesses specialized in information technologies have an extensive experience in the design, development, and management of information systems, as they have been doing such work for the business sector, generally in a very successful way, at least for the enterprises which survive (poor enterprises in this field do not last for a very long time). Consulting firms are used to performing auditing of information systems and providing technical expertise; they know how to develop a strategic plan, how to design an information system, how to implement it, and how to manage it. They even know how to train specialists and users in information technologies and specially in information systems.

Therefore, the future of information technologies in public administration lies in the cooperation between government and businesses. Instead of performing by itself consulting activities, or trying to organize computing centres, the government should learn how to contract, how to prepare terms of reference, how to draft a call for tenders, how to control the development of an information system project, how to manage the subcontractor, how to accept or refuse the result, and more generally how to use the enormous potential which exists in businesses. There are, of course, some fields in which the government cannot subcontract information systems, e.g., Defense, Police, and Justice. In these fields, the government should try to get the best possible people on the market, but when it is not absolutely necessary for security reasons, or for the sake of democracy, that the government builds and manages its own information systems, it should subcontract as much as possible to the business sector.

The role of the business sector in government information systems is not limited to consulting work and development of systems. The permanent management of an information system, even in a sensitive area as taxes or customs, can be subcontracted to the business sector, at least partly. For example, in Italy, all information systems in the Department of Finance, including tax information systems, are run by a company (SOGEI), which is purely commercial, and under government control (the government is its main shareholder through a big holding) but which works absolutely in the same way as any other company. In such cases, if the government wants to have complete control of the company, it should own 51 per cent of the capital and associate for the rest of the capital with specialized companies which work for the business sector: the experience gained in designing, developing, and maintaining information systems for businesses is of essential value for public administration. If a public agency wants to have an evaluation of its organization and procedures, instead of calling for a group of civil servants to do it, I suggest they command a specialized consulting firm for that purpose: they will be surprised by the result and by the number of jobs and the amount of money they will save through a very direct, merciless, and operational evaluation.

Concerning manufacturing of hardware and software, the government should not involve itself in this field, at least if the country has an internationally competitive hardware and software domestic industry. If such an industry does not exist, it can create a company, with the use of foreign technologies and foreign capital, and maybe give it some priority in government procurement, but only for a few years. The Bull Honeywell Company in France is a good example of what should be done (Bull Honeywell Company no longer has any right of priority in government procurement in France but it has gained a sufficient level of competence to compete, in France and in other countries, with other international firms).

There is another field in which government administration and businesses can cooperate concerning information systems: it concerns data banks for commercial use. The government administration (at national, regional, and municipal levels) gathers large amounts of data through administrative routines and through statistical procedures for its own needs (administrative operations, planning, and decision making), but government administration is definitely not good in building and managing data banks for use by businesses. At the same time, businesses need these data. Therefore, the government should encourage the creation of private enterprises using government data and making money by organizing them and selling them to the business sector. The government may or may not participate in the capital of these companies, or may or may not charge for the data given to these specialized companies.

As a conclusion, government and businesses are complementary. In general terms, the government should never do what businesses can do better. In information systems, the government should concentrate in the domains where it is indispensable that it keeps full control, and even in these fields it cannot and should not be through government departments but through specially organized companies under government control. In other domains, governments should improve their competence in the development of strategies and methodologies, and in the management of subcontractors, and act in such a way that the domestic and foreign companies will have an interest in working for the government and in keeping the government as a clientele because they make money with it and their reputation is judged by the success of the government information systems. Moreover, one should encourage the deregulation of government agencies specialized in information technologies and their transformation into semiprivate or private companies, which will be able to work outside the government and therefore develop their qualifications.

In information systems, as in any other field, competition and competitiveness are the prerequisites and absolute conditions to efficiency.

PART I: THE CHALLENGE OF INFORMATION SYSTEMS TODAY

1

USING INFORMATION SYSTEMS TO COMPETE SUCCESSFULLY IN TODAY'S WORLD: A CHALLENGE TO MANAGERS

Marvin L. Manheim

INTRODUCTION

The rapid change in information systems and telecommunications (IST) is affecting organizations of all types. This is true for organizations in the public sector, in the private sector, or mixed; and for organizations in almost all countries -- developed, newly-emerging, or less-developed. Change in IST has been rapid and will continue to be rapid. The effects of these changes in IST will continue to be significant for the foreseeable future.

No organization can ignore these changes in IST. These changes are affecting other organizations, and the organization which ignores these changes does so at its peril. More importantly, and more positively, the power of these technologies provides significant opportunities for managers in all types of organizations to use IST as a major component of their strategies for achieving their goals for their organizations.

The Second Kawasaki Seminar is based on the premise that "effective introduction of major information systems into organizations requires carefully-designed training programmes to develop the organizations' capacity to use new information technology effectively."1/ Our approach in this paper accepts this premise and puts it in a broader context:

> INFORMATION SYSTEMS AND TELECOMMUNICATIONS IS A STRATEGIC WEAPON
>
> TO BE EFFECTIVE, TECHNOLOGY CHANGE MUST BE PLANNED AND MANAGED AS PEOPLE CHANGE
>
> SYSTEMATIC METHODS ARE AVAILABLE FOR MANAGERS TO USE TO DEVELOP AN IST-BASED STRATEGY AND IMPLEMENTATION PLAN

THE MOST EFFECTIVE TRAINING PROGRAMME WILL BE ONE THAT IS DESIGNED TO SUPPORT THE IST-BASED STRATEGY OF THE ORGANIZATION

Another way to put our argument is this:

TO BE FULLY EFFECTIVE, A TRAINING PROGRAMME MUST BE DESIGNED, NOT SIMPLY AS A SET OF LESSONS IN THE TECHNIQUES OF A TECHNOLOGY, BUT AS A MAJOR COMPONENT OF SENIOR MANAGEMENT'S STRATEGY FOR ACHIEVING THE BASIC GOALS OF THE ORGANIZATION.

To summarize our views:

(1) *IST is a strategic weapon*: Managers should use IST carefully and deliberately to achieve the strategic and tactical goals of their organization. To do this, managers need to be clear about the basic goals of the organization and the strategy for achieving those goals. The strategy for using IST must be developed consistent with the basic strategy of the organization.

(2) *To be effective, technology change must be planned and managed as people change*: Effective implementation of a plan for using IST to achieve the organization's objectives requires managing technology change as people change. Managers need to identify what aspects of the way the organization works which they hope to change through the use of IST; this use must have a clear target. Managers need to involve the people of the organization who are being asked to change to participate in the process of change. Managers should use IST as a tool to stimulate creativity, innovation, and an entrepreneurial spirit in the organization.

(3) *Systematic methods can be used to develop an IST-based strategy*: Managers can develop a plan for exploiting IST effectively with the aid of systematic methods.

(4) *A training programme should be designed as an integral part of an overall strategy implementation programme.*

We will amplify on these points in the following sections.

INFORMATION SYSTEMS AND TELECOMMUNICATIONS AS A STRATEGIC WEAPON

Managerial Choices

Fundamentally, managers have three choices regarding information systems and telecommunications:

- to ignore information systems and telecommunications, treating this as a subject peripheral to their, and their organization's, concerns.

- to use advances in IST in their organization, but let the responsibilities for decisions about what to do, and how to do it, be the province of middle-level managers in technical areas concerned with information systems and telecommunications, and simply let the technology find its own markets with and within the organization.

- to use IST aggressively as part of a well-thought through strategy for achieving important goals of their organizations.

In our view, in most cases managers should adopt the third approach: IST is a strategic weapon. Managers should use IST as a major tool of organization changes and goal achievement. This requires managers to think through what their goals are, and what their strategy for achieving those goals should be.

For a private enterprise, operating in a competitive market environment, a major goal (if not the only goal) is to compete effectively. The most ambitious goal is to achieve a sustainable competitive advantage: to develop some advantages that will not only give the firm a significant competitive advantage over its competitors, but will also be sustainable -- that is, difficult for other firms to attack.2/

There is now, in the management literature, a substantial body of expertise on how private firms can or should try to achieve a sustainable competitive advantage.3/ While this literature is addressed primarily to the private firm, it is, in my view, applicable as well to public organizations, and to developing and developed countries.

Should Public Sector Organizations Seek Competitive Advantage?

There are at least three senses in which public organizations are seeking competitive advantage.

All public organizations compete in a variety of ways. First, they compete for resources and for the attention of their political constituencies. Second, it is clear that they are competing against transfer of their functions to other organizations, such as through reorganization, privatization, or even the withdrawal of services entirely. We are all well aware of the significant changes in this respect in recent years, in a number of countries.

Third, it is clear that geographic competition is also especially important. Regions of a country compete for jobs and for tourism, as do countries and regions of the world. Perhaps we might say that the central issue in development is to compete effectively in some appropriate markets: When we say that a region (or sector of an economy) is undeveloped, we are really saying the products or services of that region are not competitive in any market outside that region. If they were competitive, then they would sell (at a delivered price) sufficient to gain income and attract resources to the region and expand the production capacity.

Even in developed economies, geographic competition is especially important. Perhaps the most interesting example is the competition among cities. Within a metropolitan area, central cities, suburbs, and exurbs compete for jobs and residents. Along the coast of a continent, port cities compete for water traffic. Across a continent, airport complexes compete for air travel business: Heathrow versus Schiphol versus Charles de Gaulle -- who will dominate in the 1990s?

Especially interesting from the point of view of information systems and telecommunications is the emergence of a new form of competition: The competition of metropolitan regions for commercial and industrial development, using the combination of transportation and IST. In many regions, the business community and the public sector are beginning to work closely together to look at how investments in telecommunications and related information processing infrastructure and services will influence the relative competitive advantages of one metropolitan region versus another. This is the new arena of public sector competition: Which will be the new "city-states" of Europe? -- the Heathrow/London complex? the Amsterdam/Schiphol complex? the Paris/Charles de Gaulle complex?4/

Clearly, then, the objective of seeking a sustainable competitive advantage is applicable to all organizations, public as well as private, in developed as well as developing countries. (Of course, organizations have other goals, too, some of which may conflict with the goal of seeking a competitive advantage.)

Using IST to Achieve a Sustainable Competitive Advantage

Much has been written in the last several years about the role of information technology as a strategic weapon of the organization. The cover of *Business Week* called it "Information Power."5/ A *Fortune* article referred to such developments as "channel systems."6/ Numerous case studies have appeared which illustrate how a company can use computers, communications, software, data bases, fiber optics, robotics, artificial intelligence, and other technologies to gain a competitive advantage.7/

Examples of strategic uses of information systems are very interesting, and very useful. The specific information systems technology is not important; competitive advantage can be gained through the use of a management information system, a transaction processing system, a decision support system or an expert system, or some other variation. It is not the specific information systems technology that is important, but the way in which it is used: to assist an organization in gaining and maintaining a competitive advantage. Some examples are the following:8/

American Hospital Supply (AHS): In the 1970s, this major producer and distributor of hospital products installed terminals in some 4,000 hospitals tied directly into the AHS's order entry system. These hospitals soon became almost exclusive customers of AHS because of the ease of communication with the company and the excellent inventory control information provided by the system, which is called "ASAP." The original system has now been upgraded to use microcomputer technology and bar-code scanning to facilitate inventory maintenance, expense, and management reporting, and other features to assure that AHS continues to sustain its strategic advantages. When Baxter Travenol recently acquired AHS, it is reported that one of the major factors in the acquisition was AHS's expertise in IST.

American Hospital Supply's ASAP system is hailed as the classic case of the use of IST to gain a sustained competitive advantage. When speaking to the people who were involved in developing we are told that the original motivation of ASAP was to develop a more cost effective and reliable method to process orders for AHS's thousands of products sold to hospitals. It was only after the substantial rise in market share, resulting from having terminals installed in customer sites, that people began to realize the real strategic significance of this innovation. Since then, numerous other information systems have been been developed as strategic, e.g., systems which tie customers or suppliers directly to a company, and which make it very difficult for others to compete.

American Airlines: Another classic example is that of American Airlines (AA) which installed thousands of terminals in travel agencies connected directly to AA's reservation system called "SABRE." Thanks to reservation screens that were biased in favour of AA flights by their position at the top of each listing, AA was able to gain significant market share among agencies that installed SABRE. In addition, AA benefited from the detailed information gathered about the travel agencies and the travelers, resulting in the first "frequent flyer" programme to be introduced into the airline industry. Besides revenues generated from increased market share, AA also receives US$1.75 for each flight of competitor airlines that are booked on SABRE. Last year alone, these revenues generated about US$175 million in profits for AA.

United Airlines (UA) has developed a similar system called "APOLLO," and has retained significant market share as well. Even after American and United Airlines were forced by judicial action to provide unbiased reservation screens on their systems, they still maintain a significant edge over other airlines which have their own computer systems or which use third-party supplied reservation services. Travel agents are now used to booking AA flights on SABRE terminals and UA flights on Apollo terminals. A sustainable competitive advantage has been gained through these very extensive and expensive information systems. The *Wall Street Journal*9/ discussed the current impact that these systems are having in international airline competition.

These are examples of companies which gained a strategic advantage by strengthening their ties with their customers, and by making it increasingly difficult for their customers to buy their competitors' products. Another strategy which has been equally successful has been strengthening one's ties with one's suppliers, allowing for lower cost or higher quality production. One example of this strategy is Boeing Airplane Company.

Boeing: A key element in Boeing's success is the extensive use of computer-aided design and computer-aided manufacturing (CAD/CAM) in their development and production of aircraft. A highly sophisticated and effective computer-based system assures that every Boeing product is documented fully with design, manufacturing and maintenance specifications, and change orders as the aircraft progresses through its life cycle. Boeing now requires that its major subcontractors install Boeing's CAD/CAM systems so that engineers working at Boeing and at the subcontractors' plants can discuss design changes while looking at the same computer representation of the part in question. In this way, the quality and maintainability of the final product can be significantly enhanced. This has given Boeing an edge in selling its products worldwide.

These examples illustrate the strategic uses of information systems and telecommunications to create and sustain a competitive advantage. In each of these examples, a key characteristic of the information system was that it responded to and reflected some major element of the organization's fundamental business strategy.

The above-cited examples are well-known, and there are many others as well. Managers today can be most successful, not necessarily by copying these examples (after all, one's competitor will be aware of them too!), but by careful formulation of their business strategies and integration of the information systems in those strategies. It is possible to plan to achieve a sustained competitive advantage, and it is possible to achieve it.

The approach one takes depends, to a certain extent, on the present situation of the organization. The strategic position of an organization can be described as in one of these situations:

For the existing business of the firm (or existing mission of the organization):

(a) Internal efficiency: What does the firm need to do to achieve enough internal efficiencies to just function adequately? For example, we sometimes encounter a firm whose basic accounting and management control systems are just not functioning properly. Achieving adequate performance of these systems is a prerequisite to consideration of any more ambitious strategies.

(b) Keeping up: What does the firm need to do to achieve at least a level of competitiveness similar to that of its industry? Often, industry leaders and their close followers are moving aggressively in certain directions. To be any sort of competitor at all, the firm has to at least follow these leading firms and adopt the standards and approaches which are emerging as common throughout that industry sector. For example, in food and drug retailing in the U.S. the Universal Product Code has emerged as a standard for inventory management and point-of-sale systems. Every firm in these sectors must decide how far it will go in rebuilding its systems to use the UPC standard.

(c) What does the firm need to do to obtain a competitive advantage?

(d) What does the firm need to do to achieve a competitive advantage which will be sustainable, i.e., not eroded by a competitor's moves?

From the existing business, are there directions of new business into which the firm can grow, exploiting its present competitive advantages in IST in its present business area? This has a direct analogue in the public sector. At the First Kawasaki Seminar,10/ we argued that urban planning agencies should use their strengths in the IST area to develop new products and services separate from, but related to, their existing products and services targeted solely towards in-house support of planning and public official decision making. (For example, planning data bases could be repackaged to provide marketing information services for business users.)

For further discussion of the bases for effective competition, see the discussion below about Porter's model and generic business strategies.

TECHNOLOGY CHANGE IS PEOPLE CHANGE

A Basic Principle

Extensive experience in working to implement technology change in the field in public and private sector organizations, and in the U.S. and abroad, leads to one clear principle:11/

To be effective, technology change must be planned and managed as people change.

Why Is This Principle Important?

Some of us, perhaps, believe that good technology will create its own change mechanism -- "invent a better mousetrap and the world will," etc. This may work in a free market situation (perhaps). However, this "technological determinism" certainly doesn't work in domains where implementation of the new technology requires large shifts in human practices -- what people do, how they do it. This is especially true in the case of information systems and telecommunications.

People resist change for two good reasons: they fear the "loss of the known and tried," and they fear the uncertain future which they face if they accept the change.

There are basically two ways to deal with these natural fears. If we ignore them, the technology change may ultimately be adopted, perhaps only after much strife and wasted resources, including human resources. On the other hand, if we recognize that these fears exist and that they are natural and legitimate, and if we therefore develop an appropriate programme for dealing with these fears constructively, we can often implement a change in technology successfully and relatively expeditiously.

What Does This Principle Mean, Operationally?

The operational implications of this principle are straightforward, in outline at least:

(a) *Assessment*: Do a diagnosis of the existing situation and assess the elements which may be affected by the possible or planned change in technology.

(b) *Integrated Action Programme*: Based on this assessment, develop an integrated programme of actions ("Integrated Action Programme") to implement the change (perhaps modifying the planned change as well). Typically, this programme will include coordinated actions in these dimensions:

(i) the planned technology changes

(ii) changes in the problem-working processes (the ways people do their work) of the people who will use or be affected by the technology changes

(iii) changes in the human system -- the organization elements, both formal and informal, which influence the ways people work (e.g., reward structures, formal organization structures, job descriptions, informal communication channels, etc.)

(iv) actions to involve the people affected by the change in planning and managing the change process

(v) management actions to coordinate and adjust the implementation of the changes.

(c) *Implementation Management*: Manage the implementation of the planned changes in a flexible, adaptive way, adjusting the Integrated Action Programme as experience is gained and lessons (sometimes painful!) are learned. Keep paying attention to the people issues throughout the implementation process.

These concepts and techniques are amplified below, in a later section.

Example: Technology Change in a Multinational Firm

One company we have been studying in our research is a publicly-traded multinational. This company is in the process of implementing a technology strategy focused on a worldwide communications network with an on-line order-entry and order-status tracking system. Senior management believe this system will give them a significant competitive edge in their industry segment and they want to exploit this -- specifically, to use this system to market their products aggressively in their many markets worldwide. They believe their customers will respond very favourably to being able to access this system themselves (through their terminals, personal computers, or own mainframes), to initiate orders and to determine the status of their orders.

Using our assessment framework, we have studied this organization and assessed its capacity to implement this aggressive competitive strategy. We identified issues such as these:

- Selling this technology as a support service to the customer requires that the sales staff themselves be very familiar with the use of the technology; they are not. Therefore, extensive training of sales personnel is required.

- Historically, the salesperson sold this firm's product on a cost-competition basis; the firm historically has been a low-cost producer. This on-line system adds value to the product for the customer, through allowing him to control his own inventory better. To get this message across to the client, the salesperson has to sell at a high level in the customer organization, much higher than he has dealt with in the past. How can he get access at this level? How can he identify the "true" decision maker in the client organization? How can he articulate his message effectively at this level, to get the customer to pay more for higher value, when he has been focusing entirely on lowest cost in the past? New sales techniques are required, and perhaps some weeding out of those who cannot operate effectively in this new style.

- Present salesforce compensation is heavily oriented to commissions. To change what they do and how they do it, salespeople will have to spend substantial time in training, and (at least in their own views) will run substantial risks of failures, or of lower total dollars of sales; and thus lower commissions. The compensation system and other elements of the recognition and reward system must be examined and probably changed significantly.

- The sales staff requires effective support from the information systems staff, especially when dealing with the customer's information systems staff to determine how and whether the customer can hook into the on-line system most effectively. New job descriptions, new people, new training for selected existing staff, and perhaps a new organization, are required in the information systems area to effectively support the sales organization.

- Inevitably, this will be a more expensive sales process, although one with higher margins and hopefully higher profits at the end of the road. Thus, it is necessary to manage these sales resources more effectively than in the past. Presently, there is no marketing function, and sales management is very weak; there is no careful and systematic prioritization of prospects, evaluation of leads, and careful management of follow-through at each step of the sales process. A new style of marketing and sales management is required to efficiently target and manage the selling process. This will require a new marketing organization, new jobs, new sales management functions and responsibilities, etc.

This example demonstrates that in order to exploit its present technology lead and opportunities, this company must manage technology change as people change. Senior management need to develop an integrated action programme (as defined above), in which these changes in the human system are coordinated with the introduction of the new technology elements.

Other Examples

In a public sector context, the introduction of improved management information systems (MIS) using microcomputers is a parallel example.12/ For example, in the U.S. there is a substantial move underway to introduce microcomputer-based MIS to public agencies, especially public works agencies concerned with such infrastructure elements as roads, bridges, street lighting, etc.

These MIS are often viewed by their developers, and by the managers who request their development, as simply technical systems. Yet, if they are to be effective, in changing the ways in which the organization is managed, the introduction of improved MIS must be conceived and managed as part of a strategy to change the management practices, style, and, eventually, the organization, of the agency.

The shift of the technical tools for transportation planning from irrelevant, large-scale computer models, to new, policy-responsive methods using pocket calculators and microcomputers is another example of technology change managed as people change.

A SYSTEMATIC APPROACH: THE INFORMATION TECHNOLOGY STRATEGIC ASSESSMENT13/

Objectives of the Information Technology Strategic Assessment

We turn now to address the question: What process can managers follow to identify strategic information system options for their company and implement a strategy successfully?

This question essentially concerns strategic management: the management of the process of developing, analysing, and implementing competitive strategies using information systems. Some of the specific questions which need to be addressed include:

(1) What process should a company follow to develop and analyse its strategic choices?

  (a) Options: What are the major options in information systems elements of a business strategy?

  (b) Strategic opportunities: How can we identify possible opportunities for using IS for competitive advantage for our company or organization? How can we identify possible threats to our organization arising from the use of IS by competitive organizations?

  (c) Strategy assessment: How can we analyse and evaluate alternative IS-based strategies?

(2) What process should a company follow to manage effectively the implementation of its chosen strategy?

  (a) Implementation planning: How can we develop an effective implementation plan for the strategy we choose?

  (b) Planning processes: What should be the process of IS planning? How should the IS process relate to the general strategic planning process for the strategic business unit?

(3) What organizational changes should a company adopt to help develop and maintain its competitive advantage?

  (a) Organizational issues: How should a company organize for effective planning and plan implementation to use IS for competitive advantage?

  (b) Strategic alliances: How should a company evaluate possible alliances with other organizations to achieve strategic advantage?

Part of our research involves the development of a comprehensive methodology for strategic management using IST; we call this approach the "Information Technology Strategic Assessment," or ITSA. Our objective in this research is to provide a structured approach to assessing and evaluating an organization's strategies and opportunities and to managing the resulting implementation process.

In the following sections, we will present some elements of this methodology and suggest some partial answers to these questions.

The Phases of an Information Technology Strategic Assessment

The ITSA approach consists of four major phases:

(1) diagnosis and assessment

(2) strategy formulation and analysis

(3) strategy adoption and implementation planning

(4) implementation, monitoring, and adjustment.

Each phase addresses a few basic questions which managers should consider in thinking about information systems and their strategic implications.

We will outline some of the major steps that a company might follow and we will give some examples. It is important to recognize that just as the specific IST strategy must be tailored to the particular company, so must the specific planning process be designed appropriate to the particular personality and circumstances of each company. We do not intend the ITSA methodology as a rigid set of procedures, but as a flexible set of tools and approaches to be applied in each company situation in a way appropriate to that situation.

To emphasize this, let us first look at what we are trying to achieve, in a general way: sound strategic management. What are the characteristics of sound strategic management? In our view:

(a) a company knows where it wants to go, based on thoughtful analysis including assessment of opportunities and their consequences;

(b) the company moves towards achieving those goals, with a deliberate programme which evolves as necessary to meet changing opportunities and threats;

(c) management and workers share values and enthusiasm and work collaboratively towards the goals.

In this spirit, our discussion in the following sections should be viewed as a guide, to be adapted to each specific situation. Other approaches may be found in the literature.14/ In some parts of the ITSA, we have drawn on portions of these works.

DIAGNOSIS AND ASSESSMENT

The objective of the diagnosis and assessment phase is to assemble relevant information, analyse it, diagnose the strengths and weaknesses of the company's present situation and likely future situation, and assess the key issues which the strategic planning process should address.

The major types of data to be collected include:15/

(1) the external actors relevant to the firm:

  (a) the firm's customers -- the relevant market segments, their motivations and unmet needs, and if the customers are other firms, their value chains, present and potential uses of information systems.

  (b) the firm's suppliers -- their value chains, strengths and weaknesses, costs and performance, present and potential uses of information systems.

  (c) the firm's competitors -- their identity, including existing competitors and potential new competitors, their strengths and weaknesses, their value chains, costs and performance characteristics, their objectives, organizations, cultures, and present and potential competitive strategies, including present and potential uses of information systems.

(d) firms with which strategic alliances have been formed or might be formed -- their strengths and weaknesses, their value chains, cost and performance characteristics, their objectives, organizations, cultures, and present and potential strategies, including present and potential uses of information systems.

(e) linkages among these firms -- present and potential links among specific value activities, and especially those links supported by information systems actually or potentially.

(2) the environment of the firm -- present and potential future trends, forces, threats, and opportunities in: technology, information technology, economic and market forces, demographic and cultural forces, political and governmental forces and actions; generally, this involves not only analysing trends but also hypothesizing alternative scenarios.

(3) industry analysis -- the firm's industry, in terms such as: its size, growth dynamics, structure, cost structure, barriers to entry, barriers to exit, product life cycles, and other trends and opportunities, including trends in information systems, and especially the overall attractiveness of the industry.

(4) the characteristics of the firm itself:

(a) its performance in terms of financial and other indicators (e.g., return on investment, growth, market share);

(b) its present strategies, whether explicit or implicit, their nature (e.g., which generic business strategies are being pursued), their effects, their strengths and weaknesses, problems and successes;

(c) the firm's present strategic management processes, both for general business strategy and for information systems strategy also;

(d) cost and performance, present and past levels and future trends, and advantages and disadvantages;

(e) resources and constraints -- financial, other;

(f) human resources and constraints -- people and managerial;

(g) information systems resources and constraints.

This list, while long, is not comprehensive but illustrates the variety of information that it may be useful to collect and analyse. Obviously, few firms can afford to collect all these types of information, and in full detail. Clearly, data collection priorities should be tailored to what are perceived to be the most important issues. As a practical matter, we have found that the priorities for data collection and analysis evolve as data is collected and hypotheses are formulated about the key issues.

The results of this data collection and analysis are synthesized into:

(5) an overall assessment of the firm:

(a) strengths and weaknesses -- assets, liabilities, problems, constraints, and distinctive competencies.

(b) major opportunities, threats, and strategic uncertainties.

Thus, the primary result of the first phase of the ITSA process -- this assessment -- is an identification of the key issues on which the remainder of the process should focus.

STRATEGY FORMULATION AND ANALYSIS

The Challenge of Strategy Formulation

The second phase of the ITSA process is concerned with formulating candidate strategies for the firm and analysing them. While this phase draws heavily on the results of the preceding phase (diagnosis and assessment), substantial additional effort is required.

The major challenge in strategy formulation is to invent a strategy with which the firm can exploit its strengths to achieve and maintain a sustained competitive advantage. This requires substantial insight and creativity. Most importantly, to fully exploit information technology, strategy formulation requires substantial insights both into basic business strategy and into information technology and its possibilities and ramifications.

Relation of IST Elements to Basic Business Strategy

Clearly, a first step in a strategic planning process is to determine and analyse the present business strategies of the firm. These strategies may be explicitly stated by management or may only be implicit in management actions and/or policies. This analysis of the present strategies can then serve as one input to developing and assessing alternative proposals for the future strategy of the firm, and particularly where appropriate IST options might be applied strategically.

In some cases, IST options may simply be a means of implementing elements of the already-accepted basic business strategy of the organization. In general, however, the consideration of IST options will lead to significant modification of previously-determined business strategies, or, in many cases, the development of major new strategies.

Generic Business Strategies

We now turn to examine the question: What types of generic business strategies should a company consider for achieving and maintaining a competitive advantage?16/

The generic business strategies which can lead to competitive advantage for the enterprise include reducing the bargaining power of customers and/or suppliers by such methods as strengthening the firm's linkages with them, limiting entry of competitors into the industry or sector, reducing the possibility for product substitution, becoming the low-cost supplier of a product or service, creating and marketing a differentiated product or service, and/or establishing a significant niche for one's product or service.

Examples of these strategies are:

(1) Reducing bargaining power of customers and/or suppliers:

The cases given above of American Hospital Supply, American and United Airlines, and Boeing are excellent examples of this business strategy. The information systems that they developed, installed, and are constantly upgrading have created tight linkages with their customers or suppliers.

(2) Limiting entry of competitors into the industry or sector:

For a very long time prior to deregulation of the telecommunications industry in the United States, American Telephone and Telegraph (AT&T) was able the hold off new entrants by exploiting its patents, its extensive national and international telephone networks, and the highly regulated nature of the industry which it controlled. Many of these barriers to entry have now disappeared as numerous vendors compete in the worldwide telecommunications market.

(3) Reducing the possibility for product substitution:

Today the American steel industry is under severe pressure from substitute products, like plastics, in the production of automobiles. To counter this threat, the industry has undertaken major research projects and close marketing and technical collaboration with their automobile-industry customers to assure a continuing high content of steel in the automobiles of the future.

(4) Becoming the low-cost supplier:

Hyundai, the Korean car manufacturer, has entered the U.S. and Canadian markets with a low price strategy to compete against the higher-priced Japanese imports. To sustain their competitive advantage, the Japanese are countering this competition with a niche strategy that no longer emphasizes price, but rather quality and features.

(5) Creating and marketing a differentiated product or service:

Apple developed the Macintosh with a clear strategy of differentiation: a product which did not adhere to the IBM-created standards for PCs, but which would provide innovative features in user-friendliness and functionality. Apple continues to stress differentiation as they have enhanced the MAC with such features as high-quality laser printing. These enhancements have led to the next strategy in this list.

(6) Establishing a significant niche for one's products or services:

Apple has created a new industry called desktop publishing by producing and successfully marketing the hardware and software that permit almost any size of organization to produce high-quality printed material with its own Macintosh and laser printer.

USING INFORMATION SYSTEMS

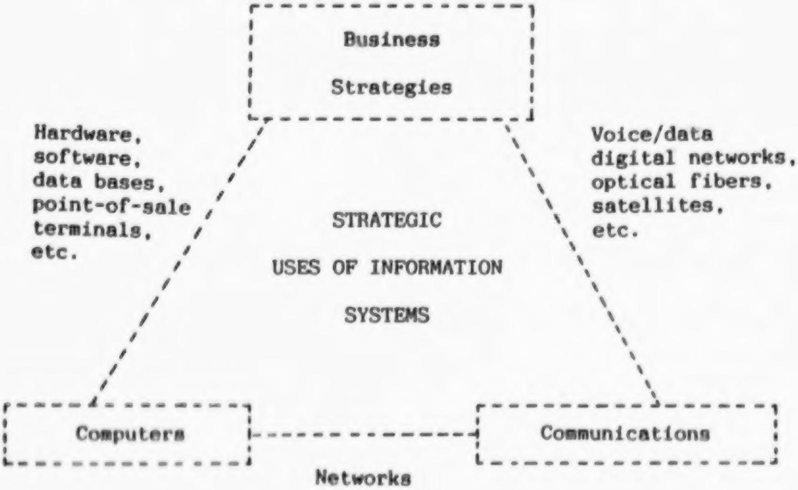
Options

What are the major options in information systems elements of a business strategy? A careful analysis of recent trends in the evolution of information systems options requires a broad perspective on the options to be considered.

The technologies which can enter into the generic strategies range from traditional mainframes and minicomputers to personal computers and communication networks, data base systems, decision support systems, integrated voice/data digital systems, electronic mail, CAD/CAM, robots, vision systems, voice analysis and synthesis systems, expert systems, videotex, and videoconferencing. A picture like that shown in figure 1, Basic Information Technology Options, emerges.

Traditionally, top executives have left the consideration of information systems applications and technologies in the hands of their MIS staffs. This is now changing as more executives begin to realize the real potential of such systems for strategic directions which they wish the company to pursue. A strategy to introduce higher quality and better maintained products may lead to the installation of powerful engineering workstations in a local area network environment. A push to ensure fully stocked retail shelf space can evolve into a system for point-of-sale capture of raw sales data, followed by analysis and exploitation

Figure 1. Basic Information Technology Options

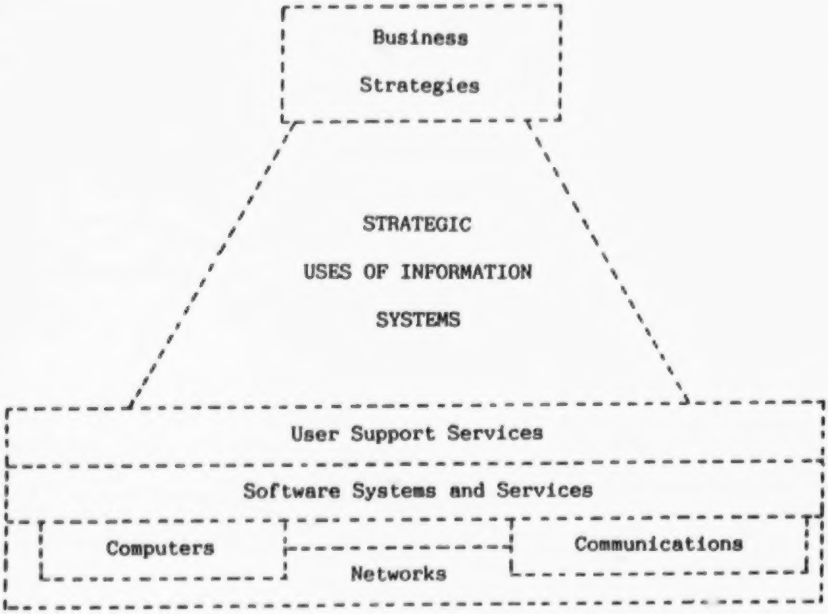

Business
Strategies
Hardware,
software,
data bases,
point-of-sale
terminals,
etc.
STRATEGIC
USES OF INFORMATION
SYSTEMS
Voice/data
digital networks,
optical fibers,
satellites,
etc.
Computers
Communications
Networks

of the resulting inventory information. A strategy to improve customer relations in a bank and to promote a forward-looking image may result in the development of a loan-officer expert system to improve the effectiveness and efficiency of dealing with valued clients.

These technologies need to be studied from a new focus, a strategic focus which presupposes a thorough knowledge and understanding of the business and its basic strategies. However, these technologies must be related, as well, to specific activities of the firm.

In a broader view, figure 1, Basic Information Technology Options, is expanded to include a number of additional elements, as shown in figure 2, Information Technology Options -- Expanded Set.

Figure 2. Information Technology Options -- Expanded Set


Business
Strategies
STRATEGIC
USES OF INFORMATION
SYSTEMS
User Support Services
Software Systems and Services
Computers
Communications
Networks

Key elements emphasized in figure 2 include:

(a) The growth of end-user computing, in which the users themselves take primary responsibility for shaping their computer support.

  (i) This is seen in the tremendous growth of microcomputer usage, in which users, not programmers, design their own spreadsheets, data bases, and other specialized applications.

  (ii) This is also seen in the mini and mainframe environments in the growth of fourth-generation languages and application development systems which do not require highly-trained programmers.

  (iii) A third dimension of this phenomenon is departmental computing, in which minis or small mainframes or networked microcomputers are wholly under the control of a user department (e.g., marketing).

(b) The tremendous broadening of the products and services offered by the information systems organization, including:

  (i) microcomputers as well as minis and mainframes;

  (ii) a wide range of software support;

  (iii) training and consulting services to assist end-users in developing their own applications;

  (iv) a range of systems concepts, including transaction processing, management information systems, decision support systems, executive support systems, and expert systems and other artificial intelligence-based systems concepts.

(c) The evolving conception of the organization of the information systems function, with

  (i) more emphasis on decentralization of support to users;

  (ii) conversely, greater emphasis on centralized coordination of certain key elements, such as data base administration, telecommunications and computer integration, and software support;

(iii) higher visibility and authority for the senior information systems personnel (note for example the emergence of the Chief Information Officer, or CIO, at the level of the Chief Financial Officer).

Techniques for Identifying Strategic Opportunities

How can we identify possible opportunities for using these IST options for competitive advantage for our company or organization? There are a number of techniques which can be useful in stimulating the identification of opportunities:

(a) specific techniques have been proposed by Ives and Learmonth, Congdon, and others.17/

(b) among these techniques, Porter's "value chain" concept is of particular note, and will be described below.

(c) in general, techniques for stimulating creativity and insight can be useful, such as brainstorming, the Delphi method, Alexander's method, morphological analysis, and others.18/

(d) general creativity techniques can be combined with competitive strategy concepts, such as Wiseman's Strategic Options Generator approach, based on morphological analysis (described below).

(e) techniques from the general strategic management and strategic marketing literatures can also be useful, such as product-market segmentation analysis (described below).

In all of these methods, the process of search for strategic opportunities is guided by the results of the assessment of key issues facing the firm, developed in the first phase of the ITSA process, Diagnosis and Assessment. Other, more detailed information collected in that phase is also valuable -- for example, the information on particular value activities, linkage between activities, and other elements.

Applying Porter's Value Chain Concept

Activities of the enterprise

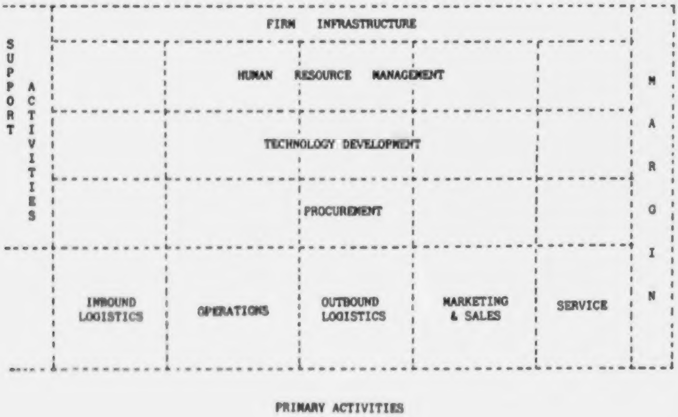
The Porter value chain concept can provide a starting point for searching for IST opportunities, since it provides a framework for studying fundamental business activities and the linkages among these activities.19/

The value chain consists of all the activities that can add value to the firm. For example, in a consumer products company, value activities are performed to design, produce, market, deliver, and support the product. They may be supporting activities, like the firm's infrastructure or human resource management functions, or primary activities like production, marketing, or sales.

Figure 3, Porter's Value Chain, illustrates the value activities for a typical manufacturing company. The company's administrative and executive functions provide the firm's infrastructure that oversees all other activities. Other support activities include the personnel functions of recruitment, hiring and training, research and product development and test, and purchasing and procurement of material and services. The primary activities of the business are defined by the flow of raw materials and finished products, as well as by the manufacturing processes, marketing, sales, and after-sale service and maintenance. This representation of the firm serves as another source of study for creating potential IS strategies.

The value activities differ from industry to industry and from firm to firm. Strategic opportunities for IT investments may be found within any of the value activities of the firm. For example, in the service departments of some automobile dealerships, simple expert systems are being used to help troubleshoot problems with customers' cars.

Figure 3. Porter's Value Chain


FIRM INFRASTRUCTURE
SUPPORT ACTIVITIES
HUMAN RESOURCE MANAGEMENT
TECHNOLOGY DEVELOPMENT
PROCUREMENT
MARGIN
INBOUND LOGISTICS
OPERATIONS
OUTBOUND LOGISTICS
MARKETING & SALES
SERVICE
PRIMARY ACTIVITIES

Linkages among value activities

As important as are the value activities themselves, the linkages among value activities often provide better opportunities for strategic IT initiatives.

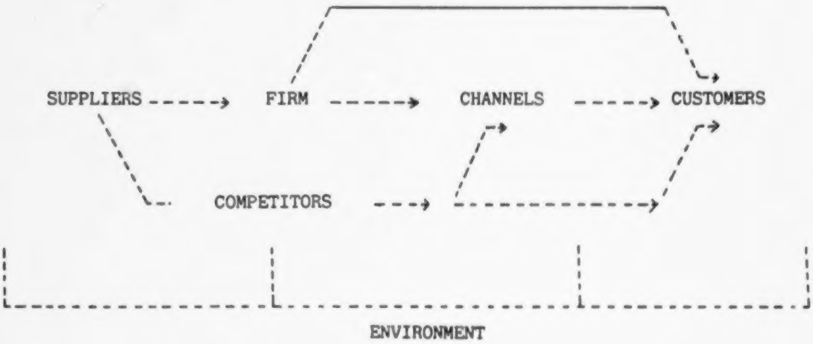
One of the best examples of a linkage which can yield strategic advantage in cost control and/or quality improvement is the use of just-in-time inventory policies. The linkage between inbound logistics and operations (manufacturing or assembly) is the place in the value chain which yields significant opportunities for IT investments to track and control inventory levels and deliveries.

Linkages are of two types: internal to the firm, and external -- connections between the firm and other firms or organizations.

External activities and linkages

The firm does not operate in a vacuum. There are numerous actors which can impact the success or failure of a given enterprise: suppliers, distribution channels, customers, and, of course, competitors. These actors operate within their own value chains and within the overall industry environment. This complex network of actors and their individual value chains represent a significant arena in which to search for, evaluate, select, and eventually implement strategic information systems (figure 4).

Figure 4. Major Actors and External Linkages



Again, the linkages among these actors and among their individual value activities can offer strategic IST opportunities. For example, in the case cited above of Boeing requiring that its major subcontractors install Boeing's CAD/CAM systems, Boeing's value activities of technology development, production and operations, marketing, and service were linked to the technology development value activity of its subcontractors.

Another illustration is General Motors' requirement that all its suppliers of automated production equipment, computers, and communications systems adhere to the GM-developed Manufacturing Automation Protocol (MAP). This standard communications protocol will ensure that all of the automated equipment in the entire chain from creation and design, through production, logistics, and transport will be able to communicate over co-axial cables, using identical message formats. GM's value activities in technology development, upstream and downstream logistics, and production and assembly are linked to their suppliers' value activities in technology development and marketing.

A final example involves the linkages of Sears' operations, marketing and sales, and service value activities with their millions of customers. Sears is using its enormous data base of information about 34 million holders of Sears credit cards to develop specialized services which go beyond its traditional mail order and in-store retail businesses into financial, banking, and real estate services, insurance, and the recently introduced "Discover" card.

Using the value chain to generate strategies

By drawing on the value chain of the firm, we can examine specific value activities and linkages among activities; for each, we can ask how particular information technology options such as those discussed above could be applied to reduce costs or improve performance or do both. We can look both at existing value activities and linkages among them, as well as possible or proposed value activities and linkages.20/

Morphological Analysis and Wiseman's Strategic Options Generator

To illustrate how these concepts might be applied, we can examine Wiseman's proposed method for generating strategic options.21/ Wiseman suggests that a manager searching for strategic information system opportunities should organize the search by constructing a matrix of "strategic targets" and "strategic thrusts," as illustrated in figure 5, Wiseman's Strategic Options Matrix. "Targets" are Wiseman's terms for the major actors in

Figure 5. Wiseman's Strategic Options Matrix

	STRATEGIC TARGETS		
STRATEGIC THRUSTS	SUPPLIERS	CUSTOMERS	COMPETITORS
DIFFERENTIATION	AA (Travel Agents)	AA AHS	
COST		AHS	
INNOVATION	Boeing	Sears	
GROWTH		Sears	AA
ALLIANCE	GM		GM

figure 4; he identifies suppliers, customers, and competitors. To this, we would add channels of distribution, as well. "Thrusts" are differentiation, cost, innovation, growth, and alliance. Once these targets and thrusts have been determined, one needs to decide whether to assume an offensive or a defensive posture vis-à-vis one's competitors and whether to become primarily a user of the technology and/or a provider of the technology.

Examples of the use of Wiseman's Options Generator illustrate how a manager might examine his own generic strategies and come up with a number of potential strategic targets and thrusts to study as candidates for creative IS strategies:

- American Airlines developed a differentiated product, SABRE, addressed to its suppliers (we would prefer the target to be distribution channels: travel agents) and to its customers. AA also targeted its competitors as a supplier of information services. While AA has taken an offensive mode in introducing and enhancing SABRE, United Airlines has developed a very successful defensive strategy with Apollo.
- American Hospital Supply developed a differentiated process of order entry, ASAP, addressed to its customers,

originally developed as a cost thrust. AHS has succeeded in developing an offensive mode as a developer and user of this technology.

- Boeing developed an innovation, its CAD/CAM system, addressed to its suppliers, i.e., subcontractors.

- Sears has initiated a number of innovations and growth strategies by acquiring companies in the insurance, financial, real estate, and banking services industries, and applying its vast information resources and communications networks to create the "Sears Financial Network" and to introduce the Discover Card. It has thus assumed an offensive posture vis-à-vis SIS initiatives, both as a user and provider of services.

- General Motors has formed strategic alliances with its suppliers and with some of its competitors by jointly developing the specifications and then implementing MAP. Some other important alliances for GM have been the acquisition of Electronic Data Systems, and joining forces with Toyota in California to produce the subcompact automobile NOVA.

Product-Market Segmentation

This approach is illustrated by the product-market segment matrix in figure 6. Segmentation is the identification of customer groups that respond differently than other customer groups to existing or proposed product offerings. A segmentation strategy is a business strategy that couples the identified segments with a programme to deliver a competitive offering to those segments. Development of a successful segmentation strategy requires the conceptualization, development, and evaluation of a competitive offering. Inevitably, the development of a segmentation scheme and the development of a competitive strategy are an interactive process: as the concept of a strategy evolves, it may be necessary to revise the market segmentation because the strategy itself creates a differentiation in the marketplace.

The Human Dimension of IST

Because of the glamour and complexity of information systems technology, there is a significant danger that the human dimensions of IST will be overlooked. The people aspects are central to the success of IST. Technology change must be planned and managed as people change.22/

Figure 6. Product-Market Segment Matrix

	MARKET SEGMENTS	
PRODUCTS	EXISTING	NEW
EXISTING	AAAAA	BBBBBBB
	CCCCC	DDDDDDD
	EEEEE	
NEW	FFFFF	GGGGGGG
	HHHHH	IIIIIII
		JJJJJJJ

The importance of people issues in IST

Human issues are important for these reasons:

- The very objective of a IST is to change the ways some people work. These may be the purchasing agents in the customer firms, the production managers in the supplier firms, or the firm's own sales, engineering, and manufacturing staffs (for example).
- To be effective, the design of computer and communications systems must take into account the ways in which people will use them. For example, one reason for the significant growth in microcomputer usage has been the quality of "user-friendly" design in most microcomputer software packages.

- People in an organization almost always fear changes, and resist them. If the IST strategy requires changes in the ways in which people work or in the organization around people -- and most IST strategies do require such changes -- then to be effective the strategy must include specific steps to overcome people's fears and resistances.

Dealing effectively with people issues in IST

Manheim has proposed a conceptual framework for use in identifying the key people issues in formulating and implementing IST. The basic concept is illustrated in figures 7-9.

Figure 7, Linking Strategy to People, emphasizes the need to have in parallel to the planned Strategic Information Systems a coordinated Human Resource Management Strategy.

Figure 7. Linking Strategy to People

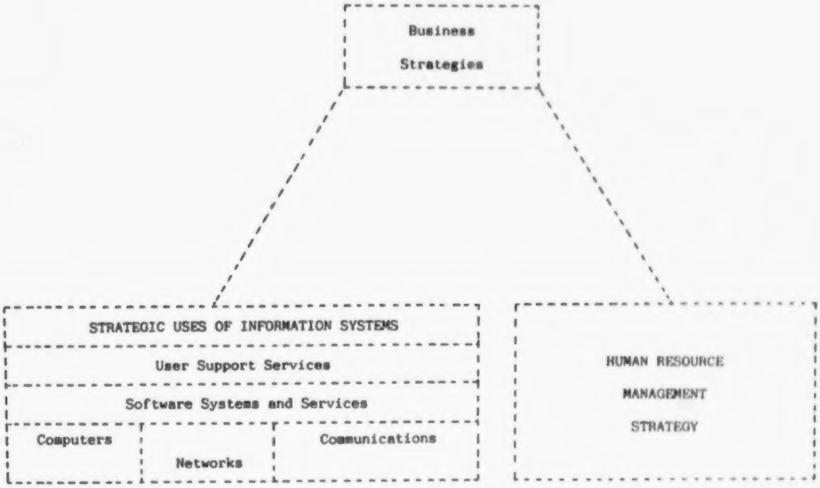
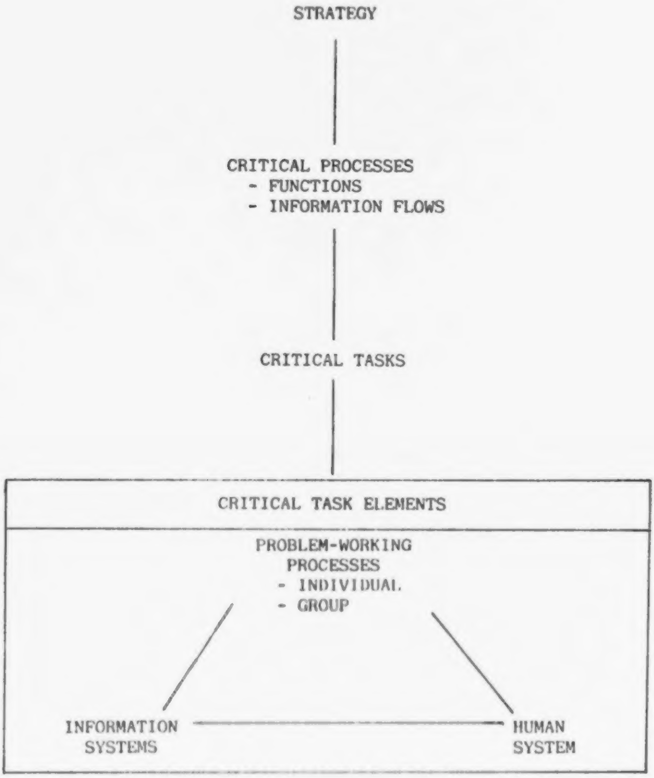

Business
Strategies
STRATEGIC USES OF INFORMATION SYSTEMS
User Support Services
Software Systems and Services
Computers
Networks
Communications
HUMAN RESOURCE
MANAGEMENT
STRATEGY

Figure 8, Translating Strategy Into Action, suggests a process for developing this coordination:

(a) The first step is formulation of a candidate business strategy.

Figure 8. Translating Strategy into Action


STRATEGY
CRITICAL PROCESSES
- FUNCTIONS
- INFORMATION FLOWS
CRITICAL TASKS
CRITICAL TASK ELEMENTS
PROBLEM-WORKING PROCESSES
- INDIVIDUAL
- GROUP
INFORMATION SYSTEMS
HUMAN SYSTEM

(b) For any strategy, there will be certain processes for which the performance is critical to the successful execution of the strategy. These critical processes must be identified. (They may span more than one value activity, and may involve external as well as internal linkages.)

(c) For each critical process, the major functions to be performed and the information flows and processing to support those functions must be identified.

(d) For each process, there will be one or more tasks whose performance is critical to the successful working of that process. These critical tasks must be identified.

(e) Tasks can be characterized usefully in terms of the individual and group processes by which people work on the problems posed by that task. For example, the task of providing a price quotation on a product may require an individual to do certain analyses and make certain judgements in order to prepare a quotation. In this process, he may consult with colleagues and with his supervisor. These individual and group problem-working processes are supported by, and influenced by, the human system around the tasks and by the information system. These three elements -- problem-working processes, human system, and information system -- are the critical elements which characterize each task and which influence the effective performance of the task. All three elements must be congruent and mutually supportive for effective and efficient performance of the task.

The major aspects of the human system include organizational culture, organizational structure, social structure, reward systems, and human resource development systems. The ability to bring about desired changes in problem-working processes may be retarded, or helped, by some of these aspects of the human system.23/

Figure 9, Integrated Action Programme, expresses a particular view about strategy implementation.

- Planned change must focus on changes in the problem-working processes of those individuals and groups who are in the target value activities or affect the target internal or external activity linkages.

- However, to be effective, planned change must also, in general, include changes in the human system as well as the information system. The information system change caused by the introduction of a IST is only part of the forces influencing the problem-working processes and task performance in the critical value activities. The human system offers incentives and constraints on the processes as well, and actions in the human system are almost always necessary to achieve effective change in the problem-working processes.

For example, a company is planning on introducing new features in its on-line order-entry and order-tracking system. These features are designed to allow the customer to access the supplier's system and do certain processing of data about his orders himself.

Figure 9. Integrated Action Programme

```
MONTHS:              0   3   6   9  12  15  18  21  24  27  30
                    +---+---+---+---+---+---+---+---+---+---+

MANAGEMENT          XXX     XXX     XXXX    XXX     XXXX   XXX
ACTIONS

INVOLVEMENT         XX  XX    XXX    XXX   XX         XXX   XX
ACTIONS

HUMAN               XXXXXX
RESOURCES                       XXXXXXXXXXX    XXXXXXX
ACTIONS                                               XXXXXX

INFORMATION             XXXXXX  XXXXXXX  XXXX
SYSTEMS                            XXXXXXX XXXXXXXXXX  XXXX
ACTIONS                                XXXXXXXXX    XXXXX XXX

PROBLEM-
WORKING                        XXXXX
PROCESS                                     XXXXXXX XXXXX
ACTIONS                                           XXXXXXXXXXX
```

- The company wants its sales force to use the availability of these features as a key element in an aggressive marketing effort. However, the sales people do not know enough about their customer's businesses to explain effectively to the customer's purchasing agent how to exploit these features for the customer's benefit.

- Therefore, for the planned strategy to work effectively, the salesforce needs substantial additional training, and upgrading, and has to develop new marketing and sales strategies and tactics to exploit the planned information systems features.

- Furthermore, in many of the customer companies the purchasing agent does not know enough about his company's broader business picture to use these features effectively, and does not have the authority within his own organization to utilize this new information effectively when provided. Therefore, part of the sales process will have to include catalyzing some involvement in the purchase decision by additional members of the customer's organization outside the purchasing department.

- In addition, the salesman will need to be accompanied by technical staff to meet with the customer's technical staff. This will upset the structure of sales commissions and profit centres, so these elements have to be reviewed and revised to be supportive of the planned strategy, rather than blocking it.

People-based change -- changes in the human system -- often will involve actions by the Human Resources (HR) staff, or others, such as:

- training, especially in managerial and team skills required by the organization changes.
- training, especially in technical skills and new technology.
- revision of job descriptions, revision of career ladders (job progression patterns), creation of new skill areas and corresponding job definitions.
- revision of reward systems, such as promotion criteria, profit-sharing, or commission or bonus schemes.
- individual counseling and evaluation for potential job reassignments.
- counseling to individuals and groups who feel threatened by the planned changes.

Timing Issues

The issues

Another central element in the formulation of IST strategy is the consideration of timing issues.24/

- Typically, major IST strategies take several years -- three to six or more years -- to plan and to implement. During this period, competitors are not standing still, markets are changing, and costs and performance of information technologies are changing, usually quite rapidly.
- Once strategy implementation begins, a firm is committed. Abandonment or substantial modification of the committed strategy usually involves significant financial and other costs.

- Competitors usually will have some lead time available to plan their countermoves. Therefore, a firm has to carefully analyse alternative hypotheses about what countermoves a competitor may take.

- While a firm may be implementing a strategy with one technology, there is always the possibility that technology may advance so rapidly that a competitor, starting later, may be able to "leapfrog" the first firm and utilize a later technology with lower costs, higher performance, and/or shorter implementation lead times.

- The speed at which a strategy can build market share over time is a key variable. When a firm is first in the marketplace with a major new IST-based strategy, there are three possibilities:

  First, the market may respond positively and very rapidly, in which case the first firm achieves a dominant market position. In the field of microcomputer software, first VISICALC and then LOTUS were clear examples of this pattern.

  Second, the market may respond positively but relatively slowly. In this case, the first firm faces the significant possibility that later entrants may leapfrog it with better cost or performance. To try to protect against this consequence, the firm needs to have clear expansion or other contingency strategies.

  Third, the market may not respond positively. The consequences of this are clear.

Timing considerations such as these require that strategy formulation consider alternative time-staged sequences of moves, alternative hypotheses about the likelihood of various competitor responses, and alternative strategies, ranging from "major bold moves" to "careful, incremental, evolutionary strategies."

Clearly, timing issues are very important in IST.

An example

The basic business of Company K is as a distributor and retailer of petroleum and LPG and related products. Its gasoline service stations and LPG stations are partially company-owned and partially franchise operations. Because of the radical drop in fuel prices in the last year, the petroleum industry is in general decline. Projections are that, for this reason and also because of intense competition, the number of service stations will be reduced by 25 per cent in the next few years in this particular country. Margins in the retail business are very small.

Company K views its basic strengths as its strong positive reputation, its chain of local outlets (gasoline and LPG service stations), and its extensive customer mailing lists. In this country, many customers do not pay cash for fuel, but instead are invoiced monthly and pay on the basis of these invoices. Therefore, Company K has had to develop customer mailing lists and related accounting software.

One element of their competitive strategy is to build a direct-marketing retail business, using catalogues. Catalogues are distributed by mail. In addition, they put displays of sample items and catalogues in the service stations; the station makes catalogues available and delivers them locally. Customers place orders on the basis of the catalogues.

In this strategy, their use of information systems is a major strategic weapon (together with their extensive service station network). They are making extensive use of their computer capabilities for targeted direct mail marketing, using their extensive computerized customer lists from the petroleum business.

The timing issue arises in the prospective evolution of this business. Company K is now moving from the first stage -- their original petroleum-based business -- to the second stage -- a direct marketing business using catalogues. In this second stage, they are marketing primarily to their existing customer bases. As this is successful, they will expand into a third stage, marketing to the larger population.

In this third stage, they will have become, essentially, direct marketers competing with other, much larger direct marketers -- established retailers, credit card companies, etc. -- in the general marketplace. To be successful in that environment, name recognition and customer loyalty are no longer sufficient competitive strengths. Company K has to become a direct marketer which is at least as strong as its major competition, with sophisticated expertise in computer-based marketing, applied to a wide range of consumer products, and marketed to a large customer base, essentially independent of their original fuel-company base. In addition, they need to have developed some new element which gives them a sustainable competitive advantage in this new, larger, competitive arena.

They may well be able to accomplish this transition, but to do so successfully they have to plan for it now and position themselves effectively at each stage. For example, they need to acquire top-rank expertise in computerized direct marketing, and in market research, to identify on which market segments and in which product line areas they should focus. They also need to continue developing their computer systems so that they continue to have a state-of-the-art capability in this rapidly-evolving field.

Conclusions: The Central Issues in Strategy Formulation in IST

To conclude this discussion: these are the essential things to recognize about the formulation of IST strategies:

- The formulation of information systems strategies is tightly intertwined with the formulation of the basic business strategy.
- The formulation of a strategy is not so much "finding" a strategy, as it is "creating" a strategy: to achieve a sustained competitive advantage, it is likely that simply copying what others are doing or are about to do will not be sufficient. Achievement of sustained competitive advantage will generally require significant innovation.
- Even innovation is not sufficient without careful consideration of timing, including lead times to launch the firm's strategy and the lead times for the firm's competitors to implement their counter moves.
- The strategy for information systems must be tightly interwoven with the human resources strategy.

STRATEGY ASSESSMENT

How can we analyse and evaluate alternative IST-based strategies?

There are a number of issues to consider in analysing and evaluating strategies, especially IST-based ones:

(1) Heavy emphasis is usually placed in strategy evaluation on the building of business simulation model:

  - The model simulates the production, distribution, and marketing functions, especially their costs, and based on a (typically simple) consumer response submodel, predicts costs, revenues, and cash flows.

70

- These are then used to calculate "pro formas," that is, projected income, profit and loss, and balance sheet statements for a period of years.

- Some experts argue that these financial projections should be used to calculate the "net contribution of the strategy to shareholder value," that is, the increase in the value of the company that would result from the proposed strategy. They also argue that this value should be the basis of strategy choice.

(2) The development of this kind of analysis is a good discipline, in that it forces the planners to make explicit their estimates (or hopes!) about costs, revenues, market responses, and so forth, and provides a consistent base of comparison of alternative strategies.

(3) However, these financial projections, while useful in helping to see the broad differences among strategies, are severely limited by the assumptions which go into them. This is especially true in the case of IST, where there is always some uncertainty about the actual costs, performance, and market effectiveness of strategies.

(4) It is important to recognize from the beginning that the assessment of alternative strategies must consider a wide range of factors, which includes many elements which cannot be quantified or expressed solely in monetary terms:

- effectiveness of a strategy in achieving corporate strategic goals

- degree of risk in a strategy, with respect to: technological uncertainties; cost uncertainties; and market response uncertainties

- extent to which a strategy is easily modified as it is implemented, versus being a major, irrevocable commitment

- extent to which a strategy is vulnerable to competitive responses.

(5) In addition to these elements, strategies may differ in important ways in the extent of implementation difficulties and uncertainties, and especially organization-

al and human resource issues.

(6) For these reasons, assessment of IST-based strategies requires a flexible approach which is sensitive to these issues.

STRATEGY ADOPTION AND IMPLEMENTATION PLANNING

Implementation Planning

How can we develop an effective implementation plan for the strategy we choose?

(1) In many situations, strategy formulation, assessment, and adoption is assumed to be finished before implementation planning is undertaken. Yet, in many, many situations, it is clear that the implementation of a chosen strategy results in the need for significant changes to that strategy:

- A good example is the ambitious strategy undertaken by Roger Smith, chairman of General Motors. Smith made several bold moves in order to bring about significant changes in GM's capabilities in information technology: the acquisitions of EDS and of Hughes. At the time of the acquisition in 1984, when asked about the differences in cultures between EDS and GM, Smith stated publicly that he hoped EDS would change GM rather than the other way around. Recently, in December 1986, the conflicts between GM and EDS reached a climax when Ross Perot, the founder and chairman of EDS, was forced off the GM board and had his stock bought out at a premium price.
- Some observers have suggested that this reflects GM's failure to recognize the depth of change required in both companies to make the acquisition work effectively. Clearly, there were significant gaps in GM's management of the implementation of its bold strategy in information systems.

(2) Development of an effective implementation plan must be integrated with the development and selection of a strategy.

(3) It is quite likely that, in the process of developing an implementation plan, issues will surface that will cause substantial modification of the selected strate-

gy, or perhaps even cause the choice of strategy to change.

(4) The diagnosis and assessment phase is the starting point of implementation planning: careful attention to analysis of the human system elements -- organizational culture, organization structure, social structure, reward systems, and human resource systems -- will lead to important insights about the potential problems likely to be encountered in implementation, as well as the strengths in the organization which can be enhanced.

Planning Processes

What should be the process of IS planning? How should the IS process relate to the general strategic planning process for the strategic business unit?

If one accepts the contention that the strategic use of information systems must respond to the basic strategies of the organization, one must be prepared to modify the strategic planning process of the organization to incorporate information technology as an explicit and major component.

As shown in figure 10, Typical Strategic Planning Process, a typical process begins with Planning Input which includes an assessment of external and internal factors, such as the environment, competition, markets, organizational strengths and weaknesses, etc., as well as elements from the organization's fundamental strategy. A Strategic Plan is usually produced, typically with a horizon of five years or longer. The Strategic Plan is the basis of an annual Operating Plan, as well as a number of Supporting Plans for human resources, capital expenditures, plant expansion, information systems, etc. There is a feedback process which involves evaluation and modification of each of these plans on a regular basis.

Given this view, it is often difficult to isolate specific information technology initiatives which, in fact, may contribute to the overall strategy of the organization, in contrast to being simply a facilitative/operational element of the plans. A modification of this process, in which information technology and information systems are included explicitly in the strategic planning cycle, provides at least the beginnings of a method to identify strategic information system opportunities. A modified process is suggested in figure 11, Planning Process with IST Emphasis.

Figure 10. Typical Strategic Planning Process

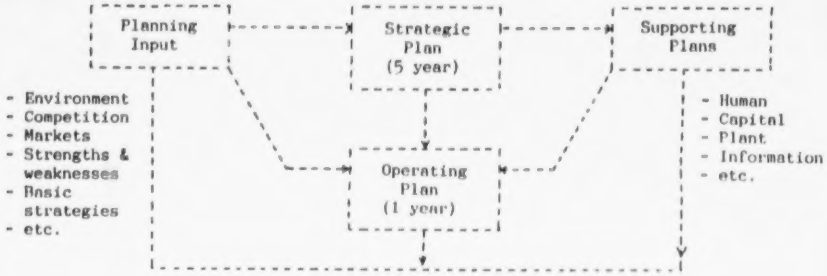
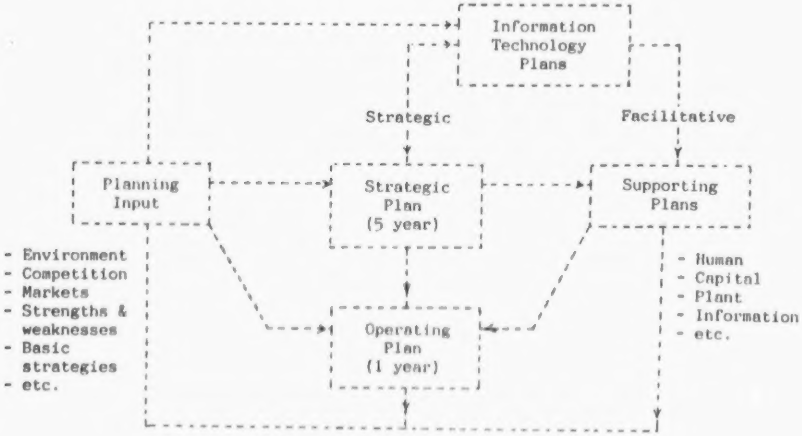

Planning Input
Strategic Plan (5 year)
Supporting Plans
- Environment
- Competition
- Markets
- Strengths & weaknesses
- Basic strategies
- etc.
Operating Plan (1 year)
- Human
- Capital
- Plant
- Information
- etc.

Figure 11. Planning Process with IST Emphasis


Information Technology Plans
Strategic
Facilitative
Planning Input
Strategic Plan (5 year)
Supporting Plans
- Environment
- Competition
- Markets
- Strengths & weaknesses
- Basic strategies
- etc.
Operating Plan (1 year)
- Human
- Capital
- Plant
- Information
- etc.

USING INFORMATION SYSTEMS

In order to determine whether there are IST opportunities which may help the organization gain a competitive advantage, it is necessary to incorporate information technology planning explicitly as a major and early step in the planning process. Since information systems are usually essential to the internal operations of the organization, they must be a part of the supporting systems, and in this capacity they play a "facilitative" function in the plan. This has been the traditional role for transaction processing and management information systems in the organization. Information technology and information systems become "strategic" when they affect or are tied to explicit elements of the corporate strategy, as discussed earlier.

These observations dictate that the ITSA should become an explicit and integral part of the basic strategic planning activities of the firm. A consideration of technology has always been a traditional element in the strategic planning process of an organization. However, this examination has usually involved technologies which are directly related to the products or services which the organization produces or sells. For example, a manufacturing company must be constantly aware of technology developments in production or assembly, like robots or automatic inspection equipment. Packaging or shipping firms must follow trends in shrink-wrap technology or palletization. What the ITSA methodology advocates is that every firm incorporates an IST strategy search in its planning process, in a major way.

ORGANIZATIONAL ISSUES

Overview of Organizational Issues

How should a company organize for effective planning and plan implementation to use IS for competitive advantage? The answers to this question inevitably must reflect the specific circumstances and personalities of each individual company. However, there are several basic observations which can be made.

Relationship between Human Resources Management and Information Systems Management

In an earlier section, we discussed the need to have human resources actions coordinated with information systems actions, as well as with other actions of strategy implementation.

This poses some interesting organizational questions, reflected in the ways in which microcomputers support is provided in many large companies. Historically, microcomputers were supported by groups outside the information systems department in some companies. In fact, microcomputer support groups tend to be very different from information systems departments, in that they are highly user-oriented. They are staffed typically more heavily with people who are good at training and at assisting users, and less heavily with sophisticated technical experts, than the typical information systems department. Often, in fact, the microcomputer support groups are located in the end-user departments, for example, in marketing, in finance, etc., rather than in a single central IS department.

Should IS support be centralized or decentralized? or should the user-support functions of IS be decentralized while the technical expertise aspects be centralized? These are interesting questions, and the answers may be dependent on the nature of the strategy. For example, if the competitive strategy involves the development and implementation of a sophisticated online system with high-speed communications among a large number of locations, then probably a centralization strategy is appropriate. On the other hand, if the competitive strategy involves getting a large number of regional and local offices to be more responsive to customers' needs through more active use of decision support systems and microcomputers, then perhaps a decentralization of user support to the regional or even local levels may be most appropriate.

The broader question is, how should human resources and information systems actions be effectively coordinated? Unfortunately, in most companies these two functional areas are very different and very far apart organizationally. Yet, if the competitive strategy involves information system changes that will also require significant changes in the way the organization functions -- both problem-working processes and the human system -- then the HR and IS actions must be closely coordinated (as suggested by figure 9, Integrated Action Programme).

For example, it may be high priority to help middle-level managers in specific functional areas -- say, marketing, sales, manufacturing, engineering -- and in specific levels of the organization -- say, regional, district, and local offices -- to develop more effective DSS and microcomputer applications. In this case, HR and IS resources need to be available to, responsive to, and highly supportive of, the individual managers. How can this delivery of HR and IS support services be effectively managed?

There are several organizational choices which should be considered.25/

(a) the existing organizational structure

(b) designating a single senior executive -- say, a vice-president -- to whom both HR and IS report, and who coordinates the delivery of their services to line managers

(c) establishing a new organizational unit to deliver coordinated services, drawing on selected staff from HR and IS

(d) merging HR and IS into a single integrated staff function to be most effective in providing people-based technology change support to line managers.

The Concept of a Chief Information Officer

The key point which has been stressed in the process for developing a SIS is the absolutely fundamental role played by the business strategy of the organization. That strategy must be clear and must be communicated to the managers who are assigned the task of coming up with plans for a SIS. Conversely, SIS plays such a fundamental role in basic business strategy that there is a strong need in the business strategy planning process for a knowledgeable and authoritative voice.

In partial response to these needs, in many U.S. companies a new upper management position is evolving to cope with the growing importance of information systems to the success of the organization: the "Chief Information Officer".26/ Just as the Chief Financial Officer or Chief Operating Officer bring their expertise and experience into the highest policy and strategy making echelons of major corporations, so now does the CIO develop and implement IT directions and strategies.

A recent interview with one of the U.S.'s most active CIOs, Peter Mather of Air Products Corporation, reveals the importance of this position and the unique qualities which a CIO must bring to the job.27/ Mather identified four major changes in information technology which led to the creation of his position:

(a) Quantum jumps in computing technology.

(b) Dramatic increase in end-user literacy and involvement in IS-related decisions.

(c) Evolution of the technologically narrow data-processing person into the business-oriented IS professional.

(d) Extension of the use of computer systems from solving back-office business problems to entering the heart of the company's operations and the marketplace.

Mather also pointed out how the management information systems (MIS) function has changed in recent years and how these changes determine the role of the CIO in the corporation:

- MIS has become a competitive necessity.
- MIS has become a recognized discipline.
- MIS departments demonstrated that they did not have an inalienable right to information technology.
- MIS changed from keepers of the keys to facilitators.
- CIO is much more concerned with general business conditions, long-range systems planning, competitive systems strategy, long-term technology integration, organization design, and the impact of change.

Even more profound changes are expected in the next five to ten years in technology and in organizations:

- Technology: true multifunction workstations for professionals, fully integrated digitized voice/data communications, electronic data interchange (EDI), better price/performance for telecommunications, global computing networks, and evolution of effective communications among diverse vendor equipment.
- Organizations: increased distribution of MIS staff, increased emphasis on multidisciplinary projects, greater need for business skills for competitive purposes, more emphasis on differentiating the company from its competitors via IS initiatives, and closer alliance among MIS and corporate planning, and perhaps marketing departments.

In Mather's view, the role of the CIO will also evolve:

- Changes in role will be company and industry-dependent, based on philosophy and competitive impact of IS.
- More time will be spent in functional leadership and policy setting; increased emphasis on search for competitive uses of IS and for the development of IT-based products.

- Responsibilities will expand to include office services and voice and data communications.

Strategic Alliances

How should a company evaluate possible alliances with other organizations to achieve strategic advantage?

Increasingly, the costs and risks of major SIS initiatives are becoming so large that companies are considering strategic alliances to share the risks:

- Complementary alliance: A newspaper publisher, a computer manufacturer, and a telecommunications company might combine to offer a new videotext or other value-added network service.

- Vertical alliance: A manufacturer, its major suppliers, and its major distributors might combine to establish an information system to serve their needs in a coordinated way to allow computer-integrated manufacturing and distribution.

- Competitive alliance: Several firms who compete may nevertheless find it in their mutual interest to join forces to create a set of systems or services to serve the industry as a whole as well as the individual firms.

- Mixed alliance: For example, GM has led other auto manufacturers, their suppliers, and the manufacturers of computer and communications equipment for factory use in the development of a coordinated set of communications standards for factory automation, the Manufacturing Automation Protocol (MAP).

IMPLEMENTATION, MONITORING, AND ADJUSTMENT

Even the best of planning cannot anticipate every eventuality. Many events in the environment of the firm may occur which call for review and possibly revision of the strategy while it is being implemented -- important competitor moves, major changes in technology performance or cost, major market changes, and so forth. Internal to the firm, unanticipated problems, or opportunities, may emerge.

It is essential that strategy implementation be managed effectively:

- There should be a single point of responsibility for implementation of all aspects of a strategy -- HR, IS, and other functional areas.

- There should be explicit milestones established for periodic review of progress, new opportunities, and problems, by the same senior officials who made the strategy adoption decision.

- There should be explicit provision for flexibility in adjusting the strategy implementation plan, or even the strategy itself, as events may require.

- Careful attention should be given to design of a monitoring and evaluation activity to assess the effects of the implemented strategy and adjust those elements which can be adjusted as actual experience is acquired on costs, performance, market response, and other key variables.

IMPLICATIONS FOR TRAINING

In preceding sections, we have discussed the strategic issues managers face, the uses of information systems and telecommunications as strategic weapons, the need to explicitly identify competitive strategy options, and the need to manage technology as people change. In the last several sections, we discussed a systematic method for doing strategic planning around IST options, the Information Technology Strategic Assessment. In this approach, the human resources actions are integrally related to the IST and other actions. A major component of the human resources programme is the training programme: A training programme should be designed as an integral part of an overall strategy implementation programme. The operationalization of this has many forms.

Training Example A: A Specific Organization

In one organization with which we are working, the training programme has gone through several phases. In the first phase, the central issue addressed was that of equipping managers at all levels with basic managerial skills -- e.g., how to be an effective supervisor. In the second phase, the training focus was on basic face-to-face sales techniques. In the next phase, the training programme is being targeted to develop sales skills specifically related to selling a product with supporting IST services (for order entry and order tracking), including:

- how to demonstrate and use the IST services,
- how to identify the customer's potential use of the IST services,
- how to identify the key decision maker in the purchasing organization with authority to purchase both the product and the related IST services,
- how to help the customer build a business case internally in his organization for purchasing the product together with the IST services, and related topics.

Training Example B: Planning Organizations in Developing Countries: Introduction

In a previous paper for UNCRD,28/ we made some specific proposals for the nature of the training programmes which should be provided to prepare information systems professionals to operate effectively in the roles we have suggested. We proposed that information systems professionals in general, and especially to support planning in developing countries, receive training in these major training areas:

(a) management -- skills and techniques

(b) organization change, role of change agent, entrepreneurial and innovation skills

(c) information systems

(d) development -- social, economic, planning, and management

(e) planning methods and models

(f) training methods, including methods for the training of trainers

We developed this proposal by first examining the evolution of IST and then relating this to the functions of planning in developing countries.

Context: Evolution of IST

First, we identified three eras of the evolution of IST in business and planning. The first era29/ was concerned with transaction processing: processing large volumes of data in an efficient manner. This was the era in which large payroll, accounting, inventory, and order processing systems were built. The second era was concerned with the development of Management Information Systems. Here the emphasis was on developing data useful for managers, through developing data bases containing operating data as well as transaction data, and through developing a variety of specialized reports for use by managers at various levels.

In the third era of computer support, the emphasis is on the concept of Decision Support Systems.30/ The objective of a DSS is to provide support to a particular set of decision needs of a manager or group of managers or department with a specialized information system. The software technology available for DSS today provides a rich variety of financial modeling, graphic, and statistical tools, with easy-to-learn languages, that allow either the user or his staff to develop and modify reports quickly. Often, DSS are implemented on minicomputers or microcomputers and so are decentralized organizationally as well as technically.

This evolution is really a revolution of service delivery concepts -- how information processing services are delivered to the user:

- In the transaction processing era, the information systems staff were the developers and, in a sense, the users. IS was running a production line almost like any other production line in the organization. The primary objective was the production of the product -- transactions -- and the production of information for decision making was secondary to this objective.

- In the MIS era, the objective was to develop reports useful for users. So, elaborate programme design methodologies were developed, in which users were consulted as to what they thought they wanted in terms of information and reports, and information systems staff went off and designed, programmed, tested, and ran the MIS. The users had only partial control over the process; system developers, constrained by staff and other resource limitations, and also by the complexity of any modifications to a large software system, were rarely able to respond to users in a timely manner.

- In the DSS era, a style is emerging which some have called "end-user computing" (EUC). In this style, the user runs the programmes himself to produce the reports he needs, and, more importantly, modifies the programmes himself to produce new reports and new graphic displays. In this activity, the user may be assisted by information systems staff in a variety of ways: by recommending hardware and software for a DSS; providing training and technical assistance, and consulting services to do tasks requiring substantial technical expertise; and providing linkages to other computers and to company and external data bases, and performing other "utility" activities.

It is particularly important to note that the technical assistance provided by the IS staff may be assistance to the user in formulating his own needs, assessing alternative approaches, and implementing his own solution. In this last role, the IS staff are no longer the primary "doers," but are support staff to the user in "doing his own thing."

In fact, in some organizations, some of these functions are being performed not by central IS staff, but by technical staff hired into the end-user's own functional department -- for example, when a marketing department hires its own programmers to support marketing staff with personal computer and minicomputer applications using specialized data bases.

Changed Style of User Support by IS Professionals

This broader role requires different skills than the traditional IS personnel typically have. This style of support to users requires the ability to relate well and easily to non-technical professionals, to work with senior managers as well as clerical staff, to help understand users' poorly-articulated needs, to teach users effectively without talking down to them, and so forth. This requires new types of personnel in the IS functional area, as well as development of new skills for existing personnel.

The implications of the third era is, in fact, a major revolution in computer support:

- The modern information systems professional has the capability to offer many different products and services in support of end-users.
- The user has become dominant: the user controls his own computing support, and does many things himself.
- As a result, the IS professional is coming more and more to focus on assisting users to use computers, and in many cases assisting them to grow significantly in their uses of computers.

- Further, as a consequence, the personal style of the IS professional is changing to become more entrepreneurial, and more catalytic in the organization.

Implications: The Missions of the IS Function in Developing Countries

This evolution of IST, and an analysis of the objectives of planning, led us to identify two major missions for the information systems function in planning organizations[31] in developing countries:

- provide support to the traditional comprehensive long-range planning activities, in which the role of planning is seen as developing a comprehensive plan and adopting it for implementation. The development process typically involves collection and analysis of large quantities of data; takes several years and large manpower resources; is oriented to the typically "long-range," with a focus ten-twenty or more years in the future; and emphasizes a quantitative, impersonal, abstract approach to planning.

- provide support to the role of the planning organization as a catalyst to social and economic development by exploiting the power of information technologies. This mission emphasizes a qualitative, people-oriented, and action-oriented approach to planning. Planning professionals deal primarily in direct human terms, working with individual farmers, businessmen, or other entrepreneurs. Their emphasis is action-oriented, for example in overcoming bureaucratic obstacles or getting small projects implemented. The objective is to solve problems and get something implemented, as a catalyst to development.

  We noted that this approach corresponds to the third era of information technology, that of user-dominated information support, or DSS; whereas the first mission corresponds to the transaction processing and MIS eras.

To provide support to the second, catalytic mission of a planning organization, the organization can work to:

A. Stimulate development of better management practices in businesses and public enterprises, outside the planning organization itself: There are a number of activities which an organization can do to stimulate development of better management practices:

(i) provide information technology-based tools to support management and planning tasks in an organization: accounting, inventory management, word processing, cash flow management; project and programme management systems, financial planning systems, fiscal monitoring and control systems, systems to support evaluation and assessment of projects; and others

(ii) train managers and supervisors, in the planning organization and other public-sector organizations, and in external private-sector organizations, in:

- (1) the accomplishment of particular tasks or functions in a more effective way, building on the use of information technology to support those tasks -- e.g., accounting, population forecasts, project management
- (2) the development of management skills through the use of IT support -- e.g., financial management through use of accounting systems and spreadsheets, management control through use of MIS and DSS systems
- (3) Some of the major areas in which these skills can be developed include:
  - (a) financial management through use of accounting and financial analysis tools
  - (b) cost analysis, pricing, depreciation and replacement, and maintenance budgeting
  - (c) marketing and sales management, using customer data bases, demographic and economic data, and methods for market research, market analysis, and market planning
  - (d) production planning, scheduling, delivery scheduling; and others

B. Stimulate development of entrepreneurial attitudes and skills in personnel of planning and other agencies, organizations, and firms: There are a number of practical things which an information systems organization can accomplish which stimulate the development of entrepreneurial attitudes and skills. The first and most important by-product of a modern approach to information systems support is the development of positive attitudes towards innovation, change, and entrepreneurial initiative; in addition, there are a number of specific skills which can be taught:

(i) the development of entrepreneurial attitudes and skills, through in part the mastery of particular computer applications, and by the opportunities to continually modify, upgrade, expand, and, in general, innovate the systems and applications which are used;

(ii) sensitivity and responsiveness to the customer (user) -- the need for the information systems professional to be sensitive to the users' needs is very valuable training for learning how to understand the needs of "customers" for any product or service;

(iii) ability to identify a market need -- a business opportunity -- arises from the same style of alertness and creativity which systems staff should develop in order to serve their user community well;

(iv) attitude of taking the initiative, and taking responsibility, similarly is developed by the systems developer in trying to follow-through on developing systems support which meets the users' needs effectively, and by the systems user, who, offered the opportunity of responsive systems support, can take the responsibility for shaping his own information systems support environment, alone or with expert help;

(v) ability to manage people, both skilled and unskilled;

(vi) ability to manage projects to time and budget;

(vii) ability to plan a business, including market studies, product development, cash flow analysis, staffing.

C. Stimulate development of specialized business activities, either in the public sector or in the private sector, based upon use of information technologies.

There are a number of specialized activities which can be developed by the information systems function of a planning organization. These are derivative of, and in many cases, directly supportive of, the basic activities in support of the traditional planning activities of the organization.

As one example, in previous work, Manheim and Schofer32/ proposed that, for urban transportation planning agencies, and other planning agencies, the information systems function be seen broadly as the basis of an "information systems utility" with these characteristics:

- information is collected on a continuing basis, from a variety of sources;

- to be integrated and coordinated on a common, geographically-coded basis, to form an integrated data base or bases and including a wide range of data types;

- the resulting resource is then used to provide a variety of information products and services;

- to a variety of different clients, including private and public sector organizations and enterprises;

- delivered in a variety of different ways.

One example of this would be the selling of social, demographic, and economic data on households in an urban area to private firms and other public agencies for use in market research and product planning. Such a service could be self-supporting or even profitable, and would develop a constituency for such data, justifying more frequent updates than might otherwise be practicable.

The activities to be undertaken to develop products and services such as this include these tasks:

- identify specific products and services which can be marketed by the planning organization, directly or through subsidiary or related organizations (public, private, or mixed), or which can be licensed to external organizations (public, private, or mixed).

- set up new organizational entities (public, private, or mixed) to develop and/or market products, when existing organizations cannot do the job.

Major Training Needs

Based on these objectives, we identified training needs in these five major areas:

(a) developing specific computer applications (software) for particular users or organization units

    (i) use of prepackaged software -- e.g., general management systems such as accounting, word processing, inventory management; and various planning models and techniques such as population forecasting, statistical analysis, graphics, transportation models, project evaluation models, etc.

(ii) use of "application-generation" packages -- e.g., developing a budget or project evaluation model using a spreadsheet package; developing a data base of businesses in a project area, or an agency mailing list, using a data base package.

(iii) use of programming languages -- e.g., FORTRAN, PASCAL, COBOL, BASIC, to develop specialized applications such as a capital budgeting model, a parking space utilization model, a housing demand simulation model.

(iv) training users in the use of the developed applications, including development of user documentation (both "on-line" and hard copy), user tutorials (both using the application and in more traditional lecture or hardcopy format), reference manuals, training scripts, training courses, and other training aids and processes.

(b) planning, designing, developing, and installing complete systems

(i) choosing hardware -- for computing, communications, display (video and hardcopy), data acquisition, etc.

(ii) choosing software -- systems, application packages, programmes.

(iii) managing the installation process, including prototyping where appropriate.

(iv) training users in the use of the system.

(c) developing and managing a user support strategy -- a strategy for providing computer support to users both within the planning organization and in external organizations

(i) identifying user needs.

(ii) understanding the organizational environment -- the structure, processes, and forces in the organization and external to the organization which may influence the goals to be achieved, the barriers to be overcome, user acceptance or rejection, etc.33/

(iii) developing a change strategy -- the formulation of the objectives of a user support strategy; what is to be achieved, how, how anticipated problems should be handled; in general, these goals should be formulated and an implementation programme designed to deal with the elements of change identified elsewhere as:34/ problem-working processes, information systems, and human system.

(iv) developing a user support programme -- a programme to provide information systems support to a set of potential or actual users:

   (1) alternative user support philosophies -- the differences in philosophies and approaches of transaction processing, management information systems, decision support systems, and end-user computing.

   (2) the role of the user in incremental development strategies -- development in stages, with user input and feedback at each stage, and user acceptance and active use before a stage is considered completed.

   (3) various forms of relations with user organizations -- within the planning agency, or external to it.

   (4) various types of services to be provided, and issues and approaches in managing the delivery of services -- consulting and advice, system procurement or loan, software selection, software development, training, standards development, etc.

   (5) strategies to develop staff to provide user support services effectively.

   (6) developing a user community, including formal and informal user groups, newsletters, electronic bulletin boards, workshops, and other activities.

(v) setting up an organization (internal or external) -- identifying and developing staff, selecting and obtaining hardware, software, training materials.

(vi) managing operations of a user support programme -- communications, application developments (doing, advising, or supporting user development activities), and system developments.

(d) developing and managing a major project or business activity

(i) basic management skills -- accounting, finance, marketing, human resources development, production and operations, organization behaviour.

(ii) specific management techniques -- business planning (including marketing planning, financial planning), managing organization change, new venture planning, strategy formulation and implementation, project management.

(e) personal skills and attitudes -- leadership, teamwork, innovation ability, change management skills, organizational sensitivity, negotiation skills, salesmanship, communication, and others.

CONCLUSIONS: ACTION AGENDAS

Moving beyond our conclusions for training programmes, we can also identify some key issues for managers and for research.

Key Issues for Managers

Our conclusions for managers are clear:

- Senior managers should take direct and personal responsibility for using IST to achieve their strategic objectives.

- A clear and comprehensive strategy for achieving the objectives of the organization should be developed, in which both basic strategy objectives and the roles of IST strategy are considered in coordination. As part of this process, particular attention should be given to what the organization needs to do to attain sustained competitive advantage in its chosen markets (whether public or private sector).

- A comprehensive strategy implementation plan should be developed, integrating technology change and people change.

- The training programme should be developed as part of the human resource development programme of the strategy implementation plan.

Key Issues for Research

The issues and techniques to be used are indeed sufficiently clear that managers can use them today. However, this is a new field. Clearly, substantial research is highly desirable, to advance the state of knowledge, and the state of practice, in this area.

- What enables an organization to gain a sustainable competitive advantage?

- What elements of IST options can be most useful as part of a successful strategy?

- What makes an implementation plan more or less successful?

- What techniques might be developed to further improve the ITSA methodology? for example, techniques for generating strategies or assessing them?

- What elements of human resource actions (as components of integrated action programmes) are appropriate for (a) different IST strategies, in (b) different types of organizations, in (c) various types of contexts (economic, social, cultural)?

- What kinds of training programmes (as components of integrated action programmes) are appropriate for (a) different IST strategies, in (b) different types of organizations, in (c) various types of contexts (economic, social, cultural)?

- How can organizations like UNCRD be most effective in promoting these kinds of research, and in disseminating the results?

NOTES

1/ United Nations Centre for Regional Development, "Aide-Memoire of the Second Kawasaki International Seminar on the Information Systems Challenge for Government and Business" (Nagoya, 1987).

2/ Michael E. Porter, *Competitive Advantage: Creating and Sustaining Superior Performance* (New York: Free Press, 1985).

3/ Ibid., see also Robert B. Lambe, ed., *Competitive Strategic Management* (Englewood Cliffs, NJ: Prentice-Hall, 1984); and Arnoldo C. Hax and Nicolas S. Majluf, *Strategic Management: An Integrative Perspective* (Englewood Cliffs, NJ: Prentice-Hall, 1984).

4/ The "new competition among the city-states" was most clearly articulated for me by Peter Keen and Frank le Clercq.

5/ "Information Power: How Companies are Using New Technologies to Gain a Competitive Edge," *Business Week* (14 October 1985): 108-16.

6/ *Fortune* (1985).

7/ R. I. Benjamin et al., "Information Technology: A Strategic Opportunity," *Sloan Management Review* (Summer 1984): 3-10; F. Warren McFarlan, "Information Technology Can Change the Way You Compete," *Harvard Business Review* (May-June 1984): 98-103; B. Ives and G. P. Learmonth, "The Information System as a Competitive Weapon," *Communications of the Association for Computing Machinery* 27 (December 1984): 12, 1193-1201; and Michael E. Porter and V. E. Millar, "How Information Gives Us Competitive Advantage," *Harvard Business Review* (July-August 1985): 149-60.

8/ Charles Wiseman, *Strategy and Computers: Information Systems as Competitive Weapons* (Homewood, IL: Dow Jones-Irwin Press, 1985); and Peter G. W. Keen, *Competing in Time: Using Telecommunications for Competitive Advantage* (Cambridge, MA: Ballinger, 1986).

9/ "Europe Bristles at U.S. Airline Computers," *Wall Street Journal* (21 November 1986).

10/ Marvin L. Manheim and Joseph Schofer, "Urban Transportation Planning Information Systems for Use in Developing Countries" in UNCRD, *Information Systems for Urban and Regional Planning: Asian and Pacific Perspectives* (Nagoya, 1986).

11/ Marvin L. Manheim, "Improving Organizational Effectiveness in a Changing World" in *Proceedings of Logistics Resource Forum* (Cleveland: Leaseway Trucking Inc., 1984); Marvin L. Manheim, *Information Technology and Organization Change: Strategies for Managers.* Fourth Annual William A. Patterson Lecture (Evanston, IL: Transportation Center, Northwestern University, 1985); Peter G. W. Keen, "Information Systems and Organizational Change," *Communications of the Association for Computing Machinery* 24 (January 1981): 1; and Eliot L. Levinson, "The Line Manager and System-Induced Organizational Change" (Working paper) (Cambridge, MA: M.I.T., 1985).

12/ Newman and Thompson (1987).

13/ This section draws on joint work with Benjamin Mittman of Northwestern University. See Marvin L. Manheim and Benjamin Mittman, "Strategic Information Systems: Using Information Technology to Gain a Competitive Advantage" (Paper presented at the Executive Seminar on Strategic Information Systems, University of Tokyo, 27-28 January 1987) (Working paper) (Tokyo: Japan Foreign Trade Council and J.L. Kellogg Graduate School of Management and the Transportation Center, Northwestern University, 1987).

14/ See Hax and Majluf, *Strategic Management*; Alan J. Rowe, Richard O. Mason, and Karl E. Dickel, *Strategic Management and Business Policy: A Methodological Approach* 2nd ed. (Reading, MA: Addison-Wesley, 1985); Keen, *Competing in Time*; Lee A. Congdon, "Using Information Systems to Gain Competitive Advantage" (Working paper) (Evanston, IL: J.L. Kellogg Graduate School of Management, Northwestern University, 1985); Manheim, *Information Technology and Organization Change*; Marvin L. Manheim, "Information Technology: A Competitive Tool for Managers" in *Proceedings of the Fourth World Conference on Transportation Research* (Vancouver, BC: University of British Columbia, 1987); and Wiseman, *Strategy and Computers.*

15/ Hax and Majluf, *Strategic Management*; Marvin L. Manheim, "The Impact of Microcomputers on Management Productivity and Organization," *Logistics and Transportation Review* (1985); and Manheim, "Information Technology."

16/ The discussion here and in some of the following sections draws in part upon Porter and Millar, "How Information Gives Us Competitive Advantage"; and Porter, *Competitive Advantage.*

17/ See Ives and Learmonth, "The Information System as a Competitive Weapon"; and Congdon, "Using Information Systems to Gain Competitive Advantage."

18/ Marvin L. Manheim, "Creativity Support Systems for Planning, Design, and Decision Support," *Microcomputers in Civil Engineering* 1 (July 1986): 1; and Marvin L. Manheim and Mark Moore, "Software Package for Strategic Analysis Using AE-1 System" (Unpublished experimental package).

19/ Porter, *Competitive Advantage.*

20/ Ibid.; see also Porter and Millar, "How Information Gives Us Competitive Advantage."

21/ Wiseman, *Strategy and Computers.*

22/ See Manheim, "The Impact of Microcomputers"; his *Information Technology and Organization Change*; and his "Information Technology"; Levinson, "The Line Manager"; and Keen, " Information Systems and Organizational Change."

23/ Burke W. Warner, *Organization Development: Principles and Practice* (Boston, MA: Little, Brown, 1983); Manheim, *Information Technology and Organization Change*; Manheim, "Information Technology"; Levinson, "The Line Manager"; Keen, "Information Systems and Organizational Change"; and J. Richard Hackman and Greg R. Oldham, *Work Redesign* (Reading, MA: Addison-Wesley, 1980).

24/ Mark A. Satterthwaite, "Pricing in Oligopolies: The Importance of the Long Run"; "Entry Deterrence and Credibility: A Numerical Example"; and "Competitive Post Entry Behavior Resulting in Idle Capacity and Blocked Entry: Notes" (Teaching notes) (Evanston, IL: J.L. Kellogg Graduate School of Management, Northwestern University, 1986).

25/ Manheim, *Information Technology and Organization Change.*

26/ "Management's Newest Star - Meet the Chief Information Officer," *Business Week* (13 October 1986): 160-64; and Arthur Anderson and Co., *The Changing Shape of MIS* (Chicago, IL: Arthur Anderson, 1986).

27/ "Views of a Chief Information Officer (CIO)," an interview with Peter Mather, CIO of Air Products and Chemicals and president of the Society for Information Management, *Indications* (Cambridge, MA) (July 1986).

28/ Marvin L. Manheim, "The Third Computer Revolution: Implications for Training in Developing Countries," *Regional Development Dialogue* 8 (Spring 1987): 122-38.

29/ This section draws heavily from Manheim, "The Impact of Microcomputers"; and his *Information Technology and Organization Change.* See also Manheim and Schofer, "Urban Transportation Planning Information Systems."

30/ Peter G. W. Keen and Michael S. Scott-Morton, *Decision Support Systems: An Organizational Perspective* (Reading, MA: Addison-Wesley, 1978); John F. Rockart and Christine V. Bullen, *The Rise of Managerial Computing* (Homewood, IL: Dow Jones-Irwin, 1986); Ralph H. Sprague and Eric D. Carlson, *Building Effective Decision Support Systems* (Englewood Cliffs, NJ: Prentice-Hall, 1982); Jane Fedorowicz, ed., *DSS-86 Transactions.* Proceedings of Sixth International Conference on Decision Support Systems (Providence, RI: College on Information Systems, The Institute of Management Sciences, 1986); and Marvin L. Manheim and Daniel Isenberg, "A Theoretical Model of Human Problem-Solving and Its Use for Designing Decision Support Systems" in Edward A. Stohr et al., eds., *Proceedings of the Twentieth Hawaii International Conference on Systems Sciences.* Vol. 1: Architecture, Decision Support Systems, and Knowledge-Based Systems (North Hollywood, CA: "Western Periodicals, 1987), pp. 614-27.

31/ We use the term "planning organization" for any agency or organization, public, semi-public, or private, involved in comprehensive or functional (e.g., transportation, housing) planning at the local, regional, or national scale.

32/ Manheim and Schofer, "Urban Transportation Planning Information Systems."

33/ Levinson, "The Line Manager"; and Manheim's book (in press).

34/ Ibid.

2

MICROCOMPUTER TECHNOLOGY AND REGIONAL PLANNING: PROSPECTS AND CHALLENGES FOR THE DEVELOPING WORLD

Richard E. Klosterman

There is no question that the world is experiencing a revolutionary advance in computer technology. If the aviation industry had advanced as spectacularly as the computer industry has over the past twenty-five years, a Boeing 767 would cost US$500 and circle the globe in twenty minutes on five gallons of fuel. These are rough analogues to the increases in speed and reductions in cost which have occurred in the computer field since the early 1960s: computational speed has increased by a factor of 200; size and energy consumption have decreased by a factor of 10,000; the cost of logic devices has declined by 25 per cent a year; and the cost of memory devices has fallen by 40 per cent a year. As a result, the personal computers of today provide an individual user with roughly the same computing power that was available on the mainframe computers of the 1960s and the minicomputers of the 1970s.1/

These technological changes have been accompanied by an equally dramatic growth in computer accessibility. The number of computers shipped in a year has increased by four orders of magnitude in less than three decades -- from about 1,000 units per year in the 1960s to nearly 10 million per year today. The estimated number of individuals with direct access to computers has grown from approximately 200,000 in 1961 to approximately 2 million in 1975 and nearly 40 million today.2/

Microcomputers have replaced the expensive and frail mainframe computers of the 1960s and 1970s with independent systems which can operate almost anywhere and are mass marketed through retail outlets. Manufacturers and programmers who once ignored computer users now compete vigorously to develop easy-to-use equipment and applications programmes for an extremely lucrative market of people with little or no previous computer experience. The result has been a democratization of computer technology which has made computer models, techniques, and information which were once the exclusive domain of a technological elite available literally around the world.

This paper examines the role of this new technology for a particularly important application -- regional development planning in the third world. The paper begins by considering the benefits of microcomputers for regional planning and the fundamental obstacles which limit their effective use in developing countries. It then reviews eight microcomputer applications for third world planning and concludes by examining the organizational and institutional issues associated with the diffusion and use of microcomputer-based planning tools in the developing world.

POTENTIAL BENEFITS OF MICROCOMPUTER TECHNOLOGY

An almost overwhelming volume of papers, publications, and conference proceedings has been generated suggesting that computers will help provide a technological solution to the pressing development problems in the third world.3/ The potential direct benefits of computer use in the developing world include: increased speed and accuracy in the processing of large quantities of information; improved procedures for report generation, display, and presentation; increased capacity for processing, storing, and transmitting data; and greatly improved analytic capabilities. Presumed indirect benefits include: potentially narrowing the gap between decision makers and analysts; facilitating more informed and expeditious -- and therefore "better" -- decision making; more efficiently utilizing limited professional resources; and adopting computer-aided models and methods from the developed countries, thereby avoiding the mistakes and costs associated with their development.4/

Four features make microcomputers particularly well suited for use in the developing world.5/ First, they are easy to maintain. Unlike mainframe computers which can only operate under carefully controlled conditions, today's microcomputers operate in the same environments as people and require only reliable electric currents. By incorporating standard "off the shelf" components, they can be serviced and even manufactured in developing nations.

Secondly, microcomputers are relatively easy to use. Hardware and software are carefully designed to be as easy to use as possible. As a result, while initial familiarization and training are required, the scarce resources of skilled computer technicians are no longer needed to use sophisticated computer tools and techniques. Third, microcomputers are highly adaptable and can be used with literally hundreds of programmes to process written documents, store and analyse data, communicate with other

97

computers, prepare graphic displays, and even play games. And, finally, microcomputers are relatively cheap and becoming increasingly less expensive. In a few years they will be available for US$100 or less, making their widespread introduction in the developing world economically feasible.

By allowing planners and analysts to perform their own analyses, microcomputers reduce coordination problems between data users who often do not appreciate the computational limitations of current technology and data processing specialists who generally have a limited understanding of the substantive nature of computer applications. By freeing analysts from the centralized controls of mainframe computers, microcomputers will also tend to reduce bureaucratic rigidity, promote flexibility, and provide a much greater potential for challenging central authority than is presently available in many developing countries.6/

The widespread utilization of microcomputers promises to transform local planning in the developed world by making sophisticated computer-assisted analytic tools and information readily available to the smallest agency and firm. However, the potential impacts of the microcomputer revolution may ultimately be much more profound in the developing world. In the industrialized world, microcomputers are broadening access to computer technologies and analytic techniques which had previously been available on mainframe computers. In contrast, computer technology has been virtually nonexistent in much of the developing world and the introduction of microcomputers is unleashing an explosion of computer power where previously there was nothing.7/

OBSTACLES TO MICROCOMPUTER UTILIZATION

As is true with almost everything in the developing world, fundamental obstacles must be overcome in implementing microcomputer-based planning tools. Microcomputer hardware and software are scarce and relatively expensive and trained computer personnel are extremely difficult to find -- and retain -- in the public sector. Fear that automation will increase dependency and promote unemployment is widespread, if largely unfounded. More fundamentally, every dollar spent on data processing is an additional dollar that is not available for purchasing food, agricultural and manufacturing equipment, consumer goods, health services, and other vitally needed commodities.8/

These problems are compounded by the lack of adequate theories, models, and information required for adequately informed regional planning and policymaking. Available theories, models, concepts, and paradigms are largely inadequate for describing the causes of, and identifying the cures for regional underdevelopment.9/ Reliable and consistent information on regional product, population and income trends, land-use and ownership patterns, and other essential information are generally unavailable at appropriate levels of disaggregation and geographic detail. Data definitions, geographic units, and collection procedures are often inconsistent and specialized data are simply unavailable. In some developing countries "official" information is assumed to be confidential. In others, information related to commercial trade, production and employment, income, landownership, and natural resources is treated as confidential. In many developing countries, politically sensitive information is used with extreme caution or suppressed entirely.10/

Studies of planning practice in the developing world reveal that the lack of adequate data has been a tremendous obstacle to local and regional planning efforts.11/ These problems reflect more fundamental factors which continue to impede the development and implementation of planning information systems in the third world. Policymakers and managers are often unaware of the need for reliable computer-based information systems. In many countries public involvement and information sharing are avoided rather than encouraged. Severe resource limitations are compounded by inadequate system designs and implementation strategies, shortages of skilled personnel and technical know-how, and a lack of coordination between existing data banks.12/

The development of decentralized information systems on microcomputers will encourage diversity and innovation in the use of information technology. However, experience at the local and state level in the United States suggests that the potential lack of quality control, technical competence, and systems compatibility may also promote unnecessary data duplication and inconsistencies. As a result, national and regional policies for the adoption and utilization of information technology and systems integration become even more essential with the widespread introduction of data bases on microcomputers.13/

CURRENT UTILIZATION

Accurate information on microcomputer use in the third world is impossible to obtain. Nevertheless, the available, largely anecdotal, evidence suggests that planning agencies in the third world are currently entering the first stage in public sector computing -- "Introduction and Conquest."14/ That is, like medium-sized American cities of the 1970s and many small planning agencies in the industrialized world today, microcomputer use in the developing world is characterized by recent adaptors with little computing capacity and staff expertise; basic computer applications centred primarily on the needs of resource controllers (usually finance and administration); slow applications growth due to limited development funds and a lack of knowledge; and low demand for computing.

These generalizations tell only part of the story, however, as planners the world over struggle to adopt these new and powerful technical tools to the realities of planning practice. An adequate picture of the potential which microcomputers have for planning in the developing world must examine specific applications and their appropriateness for the third world. Eight applications of microcomputer technology will be reviewed: planning software, electronic spreadsheets, data base management, statistical analysis and forecasting, thematic mapping, computer-aided design and drafting (CADD), geographic information systems (GISs), and expert systems.

Planning Software

Several software packages have been developed specifically for third world planning applications by various United Nations agencies, international donor agencies, universities, and foundations. For example, the United Nations Centre for Human Settlements (Habitat) has developed the Urban Data Management Software (UDMS) package, a set of four modules which can be used to create spatial data bases, prepare maps, perform spatial searches and transformations, and conduct various types of spatial analysis.15/ This package and others which are generally available free of charge to government agencies in developing countries are identified in *The Guide to Software for Developing Countries*, prepared by the IBM World Trade Corporation.16/ In addition, a number of rather sophisticated applications programmes for planning have been developed in the United States and Australia.17/ Unfortunately most of these programmes are too expensive, sophisticated, and too data intensive to be appropriate for the third world.

The application of microcomputers to planning in the developed and developing world has been severely constrained by the lack of applications software developed specifically for planning. Fundamental structural obstacles suggest that this will continue to be the case. The diversity of planning applications -- data collection, analysis, design, forecasting, and impact assessment -- and the breadth of applications areas -- land-use, economic development, environmental protection, and social services, to name a few -- mean that planners' demand for software is both sophisticated and broad. At the same time, the market for public sector planning software is extremely small and financially unrewarding, compared to more general applications areas and more lucrative professions. As a result, there is little incentive for entrepreneurs to develop the broad range of applications software required for planning -- particularly for planning in the developing world.

Electronic Spreadsheets

Electronic spreadsheets -- software packages which store numeric data in two-dimensional tables and instantly display the results of calculations on these data -- have been called with some justification "God's gift to planners." Their attraction for planning applications in developing countries is threefold. First and foremost, they are user-friendly: easy to learn, forgiving of errors, and immediately useful with only a minimal knowledge of computer fundamentals. Secondly, they are user-extendable: their simple form and logical structure provides a comfortable environment for examining any quantitative problem that can be formulated as a two-dimensional table. Sophisticated spreadsheets such as the ubiquitous LOTUS 1-2-3 also allow users to easily copy data and computational formulae from one location to another and to develop keyboard "macros" -- crude computer programmes that allow users to store and retrieve the keystrokes required for complicated computations. These powerful features not only expedite the work of experienced users but facilitate the development of customized spreadsheet "templates" which can be distributed to other users.

Most important, electronic spreadsheets build on and extend the familiar metaphor of the accountant's paper and pencil spreadsheet. This tie to the familiar allows spreadsheets to be introduced initially as mechanical devices for performing routine accounting functions more accurately and faster. However, the accounting metaphor is soon replaced by the "what if" metaphor which utilizes the spreadsheet's ability to easily and quickly determine the effect of changing selected spreadsheet entries, i.e., to determine what would happen if a particular value were changed. This makes electronic spreadsheets particularly well suited for examining "what if" questions of determining the effects of alternative policy choices and alternative assumptions about the state of nature which are an essential part of planning the world over.18/

The applicability of spreadsheets for planning analysis is reflected by the fact that previously defined spreadsheet templates have been developed for a wide range of planning applications from financial and economic analysis to population projection.19/ More important, by allowing users to develop their own analytic models, electronic spreadsheets allow planners to build

101

analytic models which address their own needs and incorporate their own insights and knowledge. The results of these "home grown" models are much more widely accepted by planners and policymakers in the third world than the output of an expatriate expert's sophisticated mainframe computer model.20/

However, the lack of applications software designed for planning purposes forces planners to use electronic spreadsheets to continually "reinvent the wheel" -- independently developing their own versions of generally useful programmes and applications. Not only is this highly inefficient, it creates the potential for misuse and abuse of analytic tools and models that are poorly understood, inadequately documented, and, all too often, computationally incorrect.21/ This problem is particularly acute in the developing world where local planners generally lack the substantive knowledge and technical training needed to develop analytic models which can best suit their needs. As a result, cumulative progress in the utilization of spreadsheets and other analytic tools will only come with the establishment of international software clearinghouses that will evaluate, document, and distribute spreadsheet templates and other applications programmes that are suitable for planning applications in the developing world.

Data Base Management

Planners not only analyse the effects of alternative policy choices and assumptions, they also accumulate and analyse large quantities of data. While spreadsheets such as LOTUS 1-2-3 can be used for these purposes, dedicated data base management packages provide substantially more speed, flexibility, and storage capacity. More important, powerful "relational" data base packages which define relationships between data elements allow users to easily develop sophisticated data bases and access, search, and sort them in a variety of ways.

Like electronic spreadsheets, data base management packages are particularly useful for developing countries because they are relatively easy to use and allow planners to define data entry screens that look like printed forms. The familiar metaphor of the data entry sheet is useful as an entry point for clerical staff and low-level professionals. However, behind this reassuring metaphor is a sophisticated data management system which can evaluate data as they are entered and be used to sort, analyse, and display the data in a number of useful and revealing ways.22/ The power of data base management packages for developing countries is reflected in the fact that the entire 1985/86 national budget for Kenya was prepared using a microcomputer data base management package.23/

An obvious application of microcomputer data base software is storing information on individual land parcels. Automated land information systems (LISs) allow planners and public officials to track the community development process and better understand the impacts of public policies on the amount, price, and location of land. Unfortunately, the lack of reliable and consistent data appropriate for planning severely limits the development of land information systems in the developing world. In addition, LISs often require thousands of hours to manually enter required parcel data and high-capacity storage devices and high-speed computers which are not available or too expensive for most developing countries. As a result, the development of LISs in developing countries will continue to lag far behind that in the industrialized world.

Statistical Analysis and Forecasting

In the last three years dozens of microcomputer packages have been developed for statistical analysis and forecasting, including microcomputer versions of the popular SPSS and SAS mainframe packages. As a result, a range of general and application-specific statistical analysis programmes are currently available for microcomputers, most of which allow data to be transferred easily from popular spreadsheet and data base packages. These packages not only provide most of the analytic routines available on mainframe computers but also provide sophisticated capabilities such as the use of graphics in exploratory data analysis, interactive data analysis and model building, and the direct integration of analysis output into reports that are generally unavailable on larger systems.24/

The development of powerful and easy-to-use microcomputer-based statistical analysis packages means that planners in the third world now have ready access to extremely sophisticated analysis and forecasting tools. However, the availability of easy-to-use high-powered analytic tools cannot overcome the lack of adequate data and properly trained personnel which characterize third world planning. Without these, the use of sophisticated analytic tools may impart a false sense of technical rigour to analyses which are no better -- and often worse -- than the hand computations they replace. As a result, here as elsewhere extreme care must be exercised in introducing powerful and easy-to-use analytic tools into environments where they are likely to be poorly understood and improperly applied.

Thematic Mapping

Thematic mapping packages allow geographically referenced information such as population densities and land-use data to be displayed graphically for geographic units such as states, regions, or individual land parcels. Readily available microcomputer-based thematic mapping packages are very useful for displaying a limited number of data values for a small number of geographical features. They are inexpensive, require minimal computer equipment, and are extremely easy to use -- making them particularly appropriate for the developing world. In addition, they can be used with popular spreadsheet and data base packages to combine data manipulation and analysis with graphic displays to graphically examine "what if" questions.

Nevertheless, thematic mapping packages are not widely used in developing countries. Most thematic packages provide pre-digitized boundary files for many geographic areas in the United States and Europe; however, these files are not available for developing countries. As a result, third world planners must purchase and use rather expensive and complex digitizing equipment. In addition, thematic mapping programmes currently offer fairly low-resolution displays, can only display a limited number of features, and are somewhat slow. Despite these problems, today's thematic mapping programmes are dramatically cheaper and easier to use than more sophisticated computer-aided design and drafting packages and geographic information systems. More so than most professions, planners are in the business of analysing and presenting geographic data. Thematic mapping programmes allow planners in the developing world to do this relatively quickly and easily.25/

Computer-Aided Design and Drafting

Computer-aided design and drafting differs from thematic mapping in providing an interactive design tool which transforms the computer screen into an electronic drawing board. CADD software is to drawing what a word processor is to writing -- allowing the user to draw, erase, modify, move, or rotate a drawing or any of its parts electronically. Microcomputer-based CADD packages provide a very useful tool for many types of planning analysis. They provide an extremely flexible interactive environment for preparing plans and drawings and can display land suitability information as a series of map overlays which can be turned off or on to depict two or more layers simultaneously. As a result, microcomputer-based CADD packages are becoming increasingly important for planners in the developed world as the field becomes more sophisticated and hardware and software advances make CADD packages increasingly better suited for planning purposes.26/

Microcomputer CADD packages are somewhat less useful for planners in the developing world, however. Professional quality CADD programmes are much more expensive, require more sophisticated hardware, and are significantly harder to use than the spreadsheet and word processing packages generally used in the third world. In addition, CADD packages are well suited for design tasks such as preparing line drawings and isometric projections which are rarely the concern of planners and poorly suited for planning tasks such as preparing and analysing high quality maps and site plans. As a result, the application of microcomputer CADD to planning in the developing world will continue to be limited to larger, more sophisticated national and regional planning agencies with access to expatriate advisors.27/

Geographic Information Systems

Geographic information systems are computer-assisted systems for the capture, storage, analysis, and display of spatial data. Unlike parcel-based land records management systems and thematic mapping packages which can only store and display information on complete land parcels, GISs can also store and display information for particular locations in space. And unlike CADD packages which store and display graphic images without associating information with these images, GISs generally include comprehensive and flexible data management capabilities. As a result, GIS packages provide sophisticated planning tools which combine powerful data storage and analysis facilities with sophisticated graphic display capabilities.

A recent survey identified sixteen GIS software packages which can be installed on microcomputers.28/ However, these systems are far too expensive for regional planners in the developing world and lack many of the capabilities of mainframe and minicomputer-based GIS systems. In addition, GIS data bases are typically very large, making the manual entry of required geographically referenced data extremely time consuming and expensive. As a result, few planning agencies in the United States are currently using these new systems and it will be some time before they are appropriate for developing countries. However, almost everything planners do is geographically-based and it is inevitable that GIS systems will eventually be available in the third world.

Expert Systems

Expert systems are computer programmes which attempt to solve real-world problems using a computer model of the reasoning process that a human expert would use if faced with a comparable problem. Expert systems generally consist of three separate elements: a set of facts, a set of decision rules, and a control programme. The control programme attempts to reach a conclusion by applying a general set of decision rules which have been previously specified by a knowledgeable expert to a particular set of facts.

Expert systems have been used successfully in chemistry and medicine and active research efforts are underway to develop them for a range of professional fields, including planning. Potential applications for planning include: (a) "intelligent" data bases which incorporate expert knowledge to help users formulate data queries and eliminate data inconsistencies; and (b) sophisticated design tools which help analyse alternative sites, find appropriate locations for specified land-uses, and assist in selecting, calibrating, and interpreting the output of complex models. Prototype expert systems have been constructed for construction project management, park management, and geographic information systems applications. Despite their tremendous theoretical appeal no fully operational expert systems are currently being used anywhere in the world and it remains to be seen whether their theoretical potential will ever be realized -- particularly in the third world.29/

DIFFUSION OF MICROCOMPUTER TECHNOLOGY

The preceding discussion suggests that microcomputer technology has the potential to transform regional planning in the developing world and identifies several fundamental obstacles that must be overcome to achieve this potential. Most of the technical obstacles will be overcome gradually with increased experience and the steady advance of computer technology. Steadily declining hardware costs will significantly reduce maintenance problems by making systems redundancy economically feasible. Problems of unreliable power supplies will be resolved with the widespread use of battery-operated portable microcomputers. And the emergence of powerful applications development programmes and *de facto* international hardware and software standards will provide an improved infrastructure for developing and distributing planning-related applications software.

However, experience in both the developing and developed worlds demonstrates that the effective use of microcomputer technology is often more dependent on organizational and political factors than on technical issues of hardware, software, and the like. Public officials and senior management must recognize the benefits of improving data processing efficiency and have an open mind towards the innovations which achieve this. Initial applications must be successful and should be seen as important. And, most important, the internal incentive system must support the use of microcomputers and the external power structure must be willing to utilize analysis results in public decision making. Without this organizational and political support, the impact of introducing powerful microcomputer tools will be negligible, at best.30/

As a result, the effective transfer of microcomputer technology is much more difficult than the transfer of other mechanical equipment such as irrigation equipment. The most difficult issue is not the introduction of microcomputer technology but institutionalizing its use in a third world environment. The initial stages of introduction tend to be highly personalized and can be initiated with outside assistance. However, the initial spurt of enthusiasm cannot ensure long-term success without substantive and administrative changes, including mundane yet important issues of equipment maintenance and supply.31/

As microcomputer hardware becomes increasingly more powerful and less expensive, microcomputer software is becoming increasingly more important and more expensive. Applications programmes for planning are not only extremely difficult to obtain but often prove to be useless by themselves. Appropriate and accurate local data must be collected and existing models must often be adapted to local concerns, conventions, and needs. Software must also be rewritten to make it available to the three-quarters of the world which does not speak English.

A great deal of software will also have to be developed in the third world themselves in tune with the culture, needs, traditions, and conventions of those countries. This will require a capacity to swim in the sea of computer culture which can best be achieved with hands-on computer use and practical experience with planning practice and issues. In these circumstances, one can foresee a great deal of research and development dealing with microcomputer-assisted methods and software, only part of which will be conducted in academic and governmental environments.32/

Planners in the third world must not only adapt and modify analytic techniques and models from the developed world, they must also develop new types of models and analyses appropriate to the environments in which they work. Simple, straightforward, and understandable analytic models and accounting techniques are much more appropriate for the developing world than sophisticated "black box" models requiring data which are simply unavailable. In these environments, the false ideal of perfect information and scientific objectivity must be abandoned for quick analysis and estimation techniques which increase the likelihood of being roughly right and not precisely wrong. With this will come an appreciation that even admittedly error-prone forecasts can be extremely useful for identifying alternative futures under different sets of plausible assumptions, describing undesirable futures which may occur if ameliorative actions are not taken, and warning to plan for uncertainty.33/

As a result, user training will increasingly be as important as the availability of hardware or software. Local planners must, of course, know how to operate computers and run prepackaged software. However, they must also understand the assumptions and limitations of the models and methods they use and be able to modify existing programmes and create new ones to meet local requirements. And, most important, they must know how to interpret and apply the information which microcomputers will produce. The increased rigour and structure which computers impose will force planners to critically examine the information they use currently. By introducing new analytic techniques and data, microcomputers will also produce new types of information that had not been available previously. However, this new and improved information will be of little value if planners do not understand it and cannot use it to improve public and private decision making.34/

International organizations such as the United Nations Centre for Regional Development can play a vital role in disseminating microcomputer technology to the third world. National training and demonstration centres can be established to give planners valuable hands-on experience with microcomputer tools and techniques. A software clearinghouse could be established to identify, evaluate, modify, and distribute software packages and spreadsheet models appropriate for third world planning. Current information on planning hardware, software, and data can also be distributed through newsletters, working papers, and international conferences.

It is important to remember that the microcomputer is only a tool. Like any tool, it is useless if not utilized, and may create a poor product if it is used incorrectly. A very good craftsman can make a fine product with inferior tools. However, a good tool makes a job easier to do, increasing the likelihood that it will be done well and often making it possible for a less-skilled workman to do a better job. The introduction of microcomputers in the developing world will not automatically reform public decision making or instantly solve the myriad problems of regional development. Nevertheless, they have already proven to be extremely useful tools which make the process of change and improvement easier in settings that are conducive to it. Given the tremendous difficulties of introducing significant changes in the developing world, a tool which makes change easier can be a precious commodity indeed.35/

NOTES

* The author gratefully acknowledges the assistance of the following individuals which made this paper possible: David B. Lewis of the Department of City and Regional Planning, Cornell University; Richard Hook and Charles K. Mann of the Harvard Institute for International Development, Harvard University; Earl J. Bell of the Department of Urban Design and Planning, University of Washington; Valerie Montenegro of the American Association for the Advancement of Science; and Kellie Masterson of Westview Press.

1/ Hoo-min D. Toong and Amar Gupta, "Personal Computers," *Scientific American* 247 (December 1982): 87.

2/ Gabriel Goren, John Leslie King, and Kenneth L. Kraemer, *The Magnitude of the Computer Revolution: Real Growth Over a Three-Decade Period* (Irvine, CA: Public Policy Research Organization, University of California, Irvine, 1986), pp. 7-8.

3/ See, for example, Mervin E. Muller, "Policies for Planning and Utilization of Computers -- Full Use vs. Effective Use" in John M. Bennett and Robert E. Kalman, eds., *Computers in Developing Nations* (Amsterdam: North Holland, 1981), p. 40.

4/ See, for example, Phillip F. Palmedo, "Energy Applications of Microcomputers in Developing Countries" in Stephen R. Ruth and Charles K. Mann, eds., *Microcomputers in Public Policy: Applications for Developing Countries* (Boulder, CO: Westview Press, 1987), pp. 59-60.

5/ International Business Machines Corporation, *The Guide to Software for Developing Countries* (Neuilly sur Seine, 1985).

6/ Britton Harris, "Does the Third World Need Computers?" (Paper presented at the Joint Meetings of the ORSA/TIMS, Atlanta, GA, 1985).

7/ Ruth and Mann, eds., *Microcomputers in Public Policy*, p. 1.

8/ Barry K. Render and Stephen K. Ruth, "The Dilemma of Acquiring Micro-based Software in Developing Countries" in Ruth and Mann, eds., *Microcomputers in Public Policy*, p. 144.

9/ See, for example, Gunnar Myrdal, *Asian Drama: An Inquiry into the Poverty of Nations* (New York: Pantheon, 1968), pp. 1941-2004; Charles Gore, *Regions in Question* (London: Methuen, 1984); and Walter B. Stohr and D.R. Fraser Taylor, eds., *Development From Above or Below? The Dialectics of Regional Planning in Developing Countries* (New York: Wiley, 1981).

10/ J. S. Edralin, "Critical Perspectives on Information Systems for Urban and Regional Planning" in United Nations Centre for Regional Development, *Information Systems for Urban and Regional Planning: Asian and Pacific Perspectives* (Nagoya, 1986), pp. 506-10; William Alonso and Paul Starr, eds., *The Politics of Numbers* (New York: Russell Sage Foundation, 1987).

11/ See, for example, the four case studies in UNCRD, *Information Systems for Urban and Regional Planning.*

12/ Chee Kim Loy, "Computerization for Land Administration and Urban Planning in Malaysia: A Case Study of Public Sector Innovation," *Computers, Environment and Urban Systems* 11 (1986): 65-72; J. S. Edralin, "Critical Perspectives on Information Systems for Urban and Regional Planning," p. 524.

13/ Itoko Suzuki, ed., "Application of Information Systems in Public Administration" in UNCRD, *Information Systems for Urban and Regional Planning*, pp. 135-64; David Moskovitz and David Mammen, "Information Technologies in Government: Organizational and Management Issues" in UNCRD, *Information Systems for Urban and Regional Planning*, pp. 165-80.

14 John L. King and Kenneth L. Kraemer, *The Dynamics of Computing* (New York: Columbia University Press, 1985), pp. 182-8.

15/ United Nations Centre for Human Settlements (Habitat), *Data Management User's Manual* 2nd ed. (Nairobi, 1983); Vincent B. Robinson and Jerry C. Coiner, "Characteristics and Diffusion of a Microcomputer Geoprocessing System: The Urban Data Management Software (UDMS) Package," *Computers, Environment and Urban Systems* 10 (1986): 165-73.

16/ International Business Machines Corporation, *The Guide to Software for Developing Countries.*

17/ See, for example, John R. Ottensmann, *BASIC Microcomputer Programs for Urban Analysis and Planning* (New York: Chapman and Hall, 1985); Robert J. Lima, *Planning Software Survey* (Planning Advisory Service Report no. 388) (Chicago: American Planning Association, 1985); and Peter Newton and

Michael Taylor, *Microcomputers for Local Government Planning and Management* (North Melbourne: Hargreen Publishers, 1986).

18/ Charles K. Mann, "Beyond the Metaphor: Microcomputers in Public Policy and Human Capital Development" in Ruth and Mann, eds., *Microcomputers in Public Policy*, pp. 11-2.

19/ See, for example, Neil G. Sipe and Robert W. Hopkins, *Microcomputers and Economic Analysis: Spreadsheet Templates for Local Government* (Gainesville, FL: Bureau of Economic and Business Research, University of Florida, 1984); Anthony J. Filipovitch, *Urban Analytic Tools: A Handbook* (Mankato, Minn.: Urban and Regional Studies Institute, Mankato State University, 1985); John D. Landis, "Electronic Spreadsheets in Planning: The Case of Shiftshare Analysis," *Journal of the American Planning Association* 51 (1985): 216-25; and Ned Levine, "The Construction of a Population Analysis Program Using a Microcomputer Spreadsheet," *Journal of the American Planning Association* 51 (Autumn 1985): 496-511. For a review and evaluation of the first templates and software designed for planning applications, see Richard E. Klosterman, "An Assessment of Three Microcomputer Software Packages for Planning Analysis," *Journal of the American Planning Association* 52 (Spring 1986): 199-202.

20/ Mann, "Beyond the Metaphor," pp. 13-5.

21/ David S. Sawicki, "Microcomputer Applications in Planning," *Journal of the American Planning Association* 51 (1985): 209-15.

22/ Mann, "Beyond the Metaphor," pp. 12-4.

23/ Clay G. Wescott, "Microcomputers for Improved Government Budgeting: An African Experience" in Ruth and Mann, eds., *Microcomputers in Public Policy*, pp. 95-116.

24/ Richard Langendorf, "Statistical Analysis on Microcomputers," *Journal of the American Planning Association* 53 (Summer 1987); Robert Cervero, "Forecasting on the PC: A Planner's Guide to Time Series Packages," *Journal of the American Planning Association* 53 (Fall 1987).

25/ Lyna L. Wiggins, "Three Low-cost Mapping Packages for Microcomputers," *Journal of the American Planning Association* 52 (Autumn 1986): 480-8; John D. Landis, "Desktop Mapping," *Planning* 52 (1986): 21-5.

26/ David F. Brown and David A. Schoen, "Using Microcomputer CAD Packages in Planning," *Journal of the American Planning*

Association 53 (Spring 1987): 249-58; Lakshman S. Yapa, "Computer-Aided Regional Planning: A Study in Rural Sri Lanka," *Environment and Planning B* (forthcoming).

27/ See Yapa, "Computer-Aided Regional Planning" for a discussion of a sophisticated application of microcomputer CADD software to rural planning in Sri Lanka.

28/ American Farmland Trust, *A Survey of Geographic Information Systems for Natural Resources Decision Making* (Washington, DC: American Farmland Trust, 1985).

29/ Leonard Ortolano and Catherine D. Perman, "A Planner's Introduction to Expert Systems," *Journal of the American Planning Association* 53 (Winter 1987): 98-102; V. B. Robinson et al., "Expert Systems Applied to Geographic Information Systems: Introduction, Review and Prospects," *Computers, Environment and Urban Systems* 11 (1986): 161-73; E. Tanic, "Urban Planning and Artificial Intelligence: The URBYS System," *Computers, Environment and Urban Systems* 10 (1986): 135-46.

30/ See, for example, John L. King and Kenneth L. Kraemer, *The Dynamics of Computing* (New York: Columbia University Press, 1985); David R. Godschalk et al., *Land Supply Monitoring: A Guide for Improving Public and Private Urban Development Decisions* (Boston: Oelgeschlager, Gunn & Hain, 1985); Sy Adler, "The New Information Technology and the Structure of Planning Practice," *Journal of Planning Education and Research* 6 (1987): 93-9; Janice Z. Brodman, "Key Management Factors Determining the Impact of Microcomputers on Decision-Making in the Governments of Developing Countries" in Ruth and Mann, eds., *Microcomputers in Public Policy*, pp. 117-42; and Wescott, "Microcomputers for Improved Government Budgeting," pp. 104-9.

31/ Carl H. Gotsch, "Applications of Microcomputers in Third World Organizations" in Ruth and Mann, eds., *Microcomputers in Public Policy*, pp. 39-48.

32/ Britton Harris, "Does the Third World Need Computers?"

33/ See, for example, Frank Young, *Rural Development Inventory, Parts I and II* (Honolulu: Technology and Development Institute, East-West Center, 1975); Detlef H. Kammeier and Barjor E. Mehta, "Microcomputer Based Evaluation and Planning Tools for Rural Center Development in Third World Countries," *Computers, Environment and Urban Systems* 10 (1985): 105-23; and G. J. D. Hewings, "Regional and Interregional Accounting Systems for Development Planning Under Conditions of Limited

Information" in L. Chatterjee and P. Nijkamp, eds., *Urban and Regional Analysis for Developing Countries* (Aldershot, U.K.: Glower, 1983). Also see Carl V. Patton, "Being Roughly Right Rather Than Precisely Wrong: Teaching Quick Analysis in Planning Curricula," *Journal of Planning Education and Research* 6 (1986): 22-9; and Andrew M. Isserman and Peter S. Fisher, "Population Forecasting and Local Economic Planning: The Limits of Community Control Over Uncertainty," *Population Research and Policy Review* 3 (1984): 27-50.

34/ Palmedo, "Energy Applications of Microcomputers in Developing Countries," pp. 61-2; Brodman, "Key Management Factors," p. 118.

35/ Thomas J. Pinkney, John M. Cohen, and David K. Leonard, "Kenya's Introduction of Microcomputers to Improve Budgeting and Financial Management in the Ministry of Agriculture" in Ruth and Mann, eds., *Microcomputers in Public Policy*, pp. 67-94.

3

THEORY OF THE URBAN ENVIRONMENTAL MASTER PLAN FOR KAWASAKI CITY AND DEVELOPMENT GUIDING PRINCIPLE FOR THE SUPPORTING PLANNING INFORMATION SYSTEM

Hidemitsu Kawakami

INTRODUCTION

Kawasaki municipality formulated the Urban Environmental Master Plan of Kawasaki City between 1983 and 1985. In this period, the City Planning Institute of Japan formed the committee in charge of plan-making, with Kawasaki municipality. In this paper, the function of the supporting information system in the planning process will be introduced and the concept of planning information and its important role in the city planning process will be described and illustrated with examples. Although information technology has greatly advanced, application of information systems in city planning still has a long way to go because the concept and real conditions of planning information still have certain weaknesses for plan-making.

OUTLINE OF THE URBAN ENVIRONMENTAL MASTER PLAN FOR KAWASAKI CITY

The Kawasaki Plan of 2001 was formulated by Kawasaki municipality in March 1983. In the plan, an image of Kawasaki by the early twenty-first century is described and the approaches to this goal are proposed. As compared with the General Plan worked out in 1973, the Kawasaki Plan of 2001 embodies an anticipative, creative environmental policy and creation of a harmonious urban environment. In the new Plan, the supplementary environmental policies, such as regulations for various sources of pollution, environmental restoration projects, and guidance policies for pollution control, were laid down to resolve various environmental problems resulting from pollution produced during the period of rapid growth. Kawasaki municipality has worked out interval plans on a four-yearly basis, as implementation programmes for the realization of the overall Kawasaki Plan of 2001. Also, there are various administrative plans for the improvement of urban facilities and industrial promotion under the supervision of various departments and bureaus. This environmental master plan was proposed as a means of control towards the realization of the above plans.

As shown in figure 12, the system of the urban environmental master plan consists of "function," "goal," and "operation" and offers information on assessment and adjustment for the decision making process of policy judgement and project planning concerned with the environment. The regional information system of the environmental master plan was developed with the aid of the supporting information system.

SIGNIFICANCE OF THE SUPPORTING INFORMATION SYSTEM

The daily or nondaily work of plan formulation under the charge of the municipal government includes the stage of preparation (investigation, analysis, forecast, and evaluation of alternative plans). In plan preparation, it is necessary to utilize accurate information with broad views for formulating a scientifically and pragmatically accepted plan.

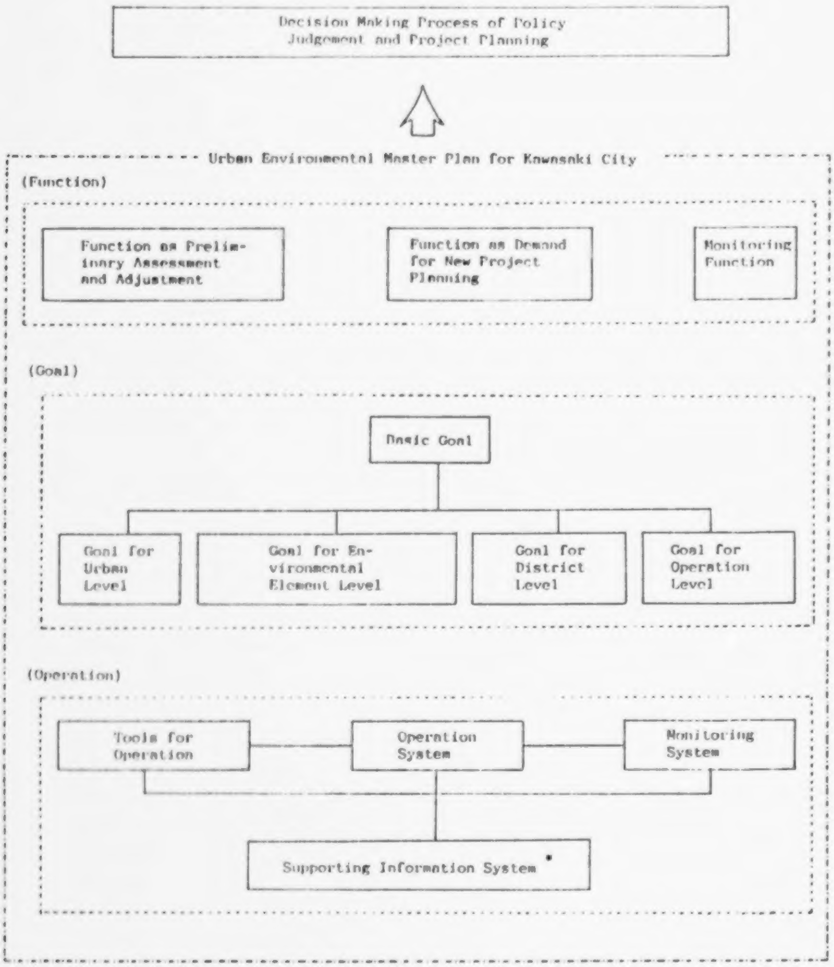
At present, manifold information used in plan preparation consists of formerly or newly collected data. Some data (for analysis, forecast, and evaluation of alternative plans) are processed by hand, while others are processed by computer.

The Plan's supporting information system performs work related to plan preparation exclusively through computer. The utilization of the computer at this stage has the following merits: The analysis capability increases and various simulations can be practiced, because a lot of data can be speedily and precisely processed. It is easy to systematically accumulate large-scale data -- necessary data of time sequence can also be easily retrieved and there is no need to worry about the loss of valuable data. Data can be multiobjectively utilized. Finally, the function of new information creation enlarges with the aid of retrieval, analysis, and graphic presentation.

In the Plan's supporting information system, generation of comprehensive mapping information and graphic presentation are time-consuming. Tabulated data are supplied through the use of a computer.

Basic data, as the foundation of the supporting information system of the plan, are stocked at the agency. Principally, they include nationally designed statistics, data generated during the daily business of the agency, and data generated for specific or nonspecific purposes (see table 3.1).

Figure 12. The System of Urban Environmental Master Planning


Decision Making Process of Policy Judgement and Project Planning
Urban Environmental Master Plan for Kawasaki City
(Function)
Function as Preliminary Assessment and Adjustment
Function as Demand for New Project Planning
Monitoring Function
(Goal)
Basic Goal
Goal for Urban Level
Goal for Environmental Element Level
Goal for District Level
Goal for Operation Level
(Operation)
Tools for Operation
Operation System
Monitoring System
Supporting Information System *

---

* Computer system supporting the work of analysis and assessment, offering real-time information about the existing situation and environment, and supporting environmental improvement.

TABLE 3.1. BASIC DATA STOCKED BY THE AGENCY

Designated government statistics	National census, office, industrial, commercial, and housing statistics
Data generated during the daily business of the agency	Residents' register, register on municipal property tax, data on building permits, measurement of pollution
Data generated regularly for a specific aim	Basic survey of urban planning, survey of road situation, person-trip survey, investigation into actual citizen attitudes, various statistical data
Data generated occasionally for a specific aim	Basic maps of various scales, enforcement of various laws, administrative boundary, boundary of school district, various documents, implementation of various projects, data generated in other agencies for a specific aim

In addition, knowledge of the land-use situation, an environmental district chart, environmental maps, and a data base of district information are also stocked in the existing system with the use of a computer.

At present, data stocked by the agency are not organized for convenient use by planners. Data other than the designated statistics are not well understood except by persons in charge of data generation and some other staff. Furthermore, there are other issues, for instance, the scarcity of time series data which makes the planners undertake vast amounts of work on the standardization of total units, summarization, and graphic presentation of data.

The utilization of computers in the application of the supporting information system of the plan will resolve the above issues. That is, a lot of data can be stocked, consistently updated with the newest data, and rapidly utilized because they are arranged in the most convenient way to assist with planning. Moreover, scientific analysis and forecast can also be executed such that the administrative efficiency increases.

Although a few supporting information systems of the plan have been operated in some departments, the programme of the whole agency system has not yet been realized.

FUNCTION OF THE SUPPORTING INFORMATION SYSTEM AND RANGE OF DATA PROCESSING

When the basic urban environmental plan is executed, a comparison between the planning goals and the current environmental situation using the latest data to determine the tasks ahead, an investigation into the environmental situation, the former plans, and measures, and the simulation of environmental change due to individual programmes, will all be frequently undertaken. Because the range of manual work is limited, a computer is indispensable for efficient performance.

The computer-supported information system for the urban environmental master plan is charged with the following functions:

(1) providing the real-time information for the formulation, revision, and execution of the urban environmental master plan;

(2) providing the easy-to-understand information in the form of maps, graphs, and photographic and linear illustration (except digital information);

(3) providing a data base to easily store large-scale data; and

(4) simple retrieval and processing of information at any time.

Because the supporting information system utilizes computers which can be freely utilized by users, it is necessary to regulate the range of systems operation.

The kind, accuracy, and processing of data handled by the supporting information system differ greatly according to the utilization programme. A system which meets users' requirements cannot be developed at present, because of its scale and complexity; additionally, the costs of development, maintenance, and operation, are extremely high.

On the other hand, because the supporting information system is able to differentiate between the area utilized by each individual plan and the area commonly utilized by various plans, a common supporting information system is being developed by each individual department.

In addition, it is necessary to enforce data privacy or protection.

REQUIREMENTS OF THE SUPPORTING INFORMATION SYSTEM

The requirements of the supporting information system are as follows:

(1) Storing the information needed for determining the environmental goals of the whole city and the various districts.

(2) Storing the information needed for defining the environmental tasks of the whole city and the various districts.

(3) Storing the information required for determining the environmental situation of the whole city and the various districts.

(4) Storing the information required for adjusting each individual plan.

(5) Preparing a manual for resolving the problems which cannot be fully coordinated with the individual plan.

(6) Storing the information necessary for measuring the effects of policies and implemented projects on the environment.

BASIC FUNCTION OF THE SUPPORTING INFORMATION SYSTEM

The basic function of the supporting information system is to determine the environmental goals. It is necessary to store and analyse data as a foundation for determining the goals during the operation stage.

Because the system's task is to select suitable goals and indicate their contents and restraints within the individual plans, there are the following additional functions:

(1) To supply reference data (including historical data), data from other cities, and national standards.

(2) To provide a simulation function.

(3) To cross-check differing goal values.

Because there is a difference between the goals and the environmental situation, it is necessary to compare them. The functions include determining the differences between the environmental tasks at the formulation stage and those at the operation stage; mastering the environmental time series data; and simplification of data for easier comprehension.

A survey of the environmental situation is necessary in defining the environmental tasks. These include collecting and managing data regarding the environmental situation; collecting micro-level data; collecting time series data; and integrating digital data with map data.

The function of adjusting and coordinating individual plans includes the simulation of the environmental changes which will result from the execution of the individual plans; the simulation and cross-checking of various individual plans; recording the adjusting process; and comparing the environmental tasks in the master plan with the results of individual plan simulation.

The function of preparing a manual for resolving problems not dealt with in the individual plan includes a definition of coordination problems.

The function of measuring the effects of the executed policies and projects on the environment includes surveying the environment after executing the policies and projects, and simulating the environment.

THEORY OF PLANNING INFORMATION

Meaning of Planning Information

Planning information denotes all the inherent information on city planning which differs from the ordinary city information. It is the information operated and processed specifically with the aim of plan formulation.

Because planning information is generated through processing the results of statistical surveys and maps and field information necessary for defining the planning tasks and the spatial character of the subjective areas to be planned, there are various kinds of planning information used in the draft plan and for planning decisions.

For example, although the topographic map of the Geographic Survey Institute is not strictly planning information, the processed maps showing the terrain, water systems, and road network, as well as the successive maps can be called primary planning information. An example would be the map of population and the map of the existing building-use and condition.

Originally, this information is used for understanding the nonphysical or social issues and representing their spatial distribution, such as distribution of land price, commercial activity, residents' organization, attitudinal survey, and time period.

Illustration of Planning Information

Information on the scale, quantity, distribution, and location of amenities is the most easily understandable and essential to planning. Such information includes roads, parks, and parking spaces, and maps indicating special land usage, and building conditions.

One task of city planning is to show the necessity to improve the parking spaces supporting commercial activity in the city centre through graphic display. For this, graphic analysis of the following data is effective:

(1) The agglomeration of business establishments and the distribution of planning space.

(2) The movement of pedestrians and the distribution of parking space.

(3) The building coverage per plot, the floor area ratio, and the parking space.

(4) The conversion of building-use and the parking space.

Further tasks for city planning are to delineate disaster-prone areas and formulate plans for urban renewal.

Planning theory can result from an analysis of the investigation into the influences on continuous and grade-separating uses of land and buildings.

Effectiveness of Planning Information

The effectiveness of planning information is related to the ability of planners to find out the character and problems of their respective cities. Effectiveness can be achieved through gathering salient information regarding the existing conditions.

The urban function and structure, expressed as a system of nuclei and axes of the subjective area, can be found through exacting special elements of maps of the built-up area and the existing building-use and conditions. Change over time periods can be expressed and compared through use of maps and graphs. Cities, districts, and facilities can be compared within the same scale. Social issues can be expressed spatially through statistical data and the results of investigation in map form. The information map can indicate development tendencies.

Contribution can be made to the conception and adjustment of the plan through provision of information based on surveys, analysis, and perspectives on the present conditions and tendencies of the district, e.g., a map of the study conditions in a given locality can be produced.

4

CHANGING DATA AND INFORMATION NEEDS FOR AGRICULTURAL PLANNING: THE CHALLENGE FOR THE DEVELOPING COUNTRIES

K. V. Sundaram

THE CHANGING SCENARIO OF DEVELOPMENT

During the last three decades, planning in the developing countries has changed its orientation from a growth-oriented paradigm to one based on "growth with equity," with the focus on a number of poverty alleviation strategies. Taking note of the demographic and structural characteristics existing in their countries, governments have instituted various programmes for building up the asset base of the poor through programmes for self-employment and wage employment, basic needs provision, integrated rural development, development of local self-reliance, and participatory development to enhance the spread of development benefits and to reach the target groups. The implementation of such programmes has also necessitated changes in the structure of development planning from centralization to decentralization in various forms. The changes in the orientation and structure of development planning is diagrammatically illustrated in figure 13. The motivation for decentralizing planning and management in the developing countries has been varied.

> In some cases, the desire of the national elite for greater political legitimacy spawned attempts at decentralization, while in others the policies were enacted in response to pressures for greater participation in decision making by ethnic, regional, religious, or tribal groups. In most countries where it was tried, decentralization was seen as a way of improving the efficiency of planning and management within the central bureaucracy and was often enacted in reaction to the stultifying slowness with which central ministries responded to pressing social and economic problems.... In a few countries, international assistance agencies brought pressure on national governments to decentralize planning and management functions as a way of

Figure 13. Schematic Diagram of Structure and Orientation of Development Planning

DEVELOPMENT STRATEGY OF PUBLIC SECTOR INVESTMENTS	GDP GROWTH WITH		GDP + WELFARE OBJECTIVES THROUGH	
	TRICKLE DOWN EFFECTS	REDISTRIBUTION THROUGH BALANCED REGIONAL DEVELOPMENT	FISCAL POLICIES AND TRANSFERS TO LOW-INCOME GROUPS	TARGET GROUP PARTICIPATION AND ENTITLEMENT PROGRAMMES

ORIENTATION

	STRUCTURE
CENTRAL PLANNING	
DECONCENTRATION	
DECENTRALIZATION	
LOCAL SELF-RELIANCE	

Source: K. V. Sundaram, "An Integrated Approach to Training for the Establishment and Use of Information Systems for Subnational Development Planning," *Regional Development Dialogue* 8 (Spring 1987).

dealing with the serious and growing disparities in income and wealth among regions. In more than a few countries, decentralization may have been seen as a convenient way for national leaders to rid themselves of responsibility for regional and local development problems by transferring them to local units of government or private organizations.1/

Whatever the motivation for decentralization may be, the country experiences reveal a wide gap between objectives and results.2/ Two important directions in which developing countries have faced serious problems are in regard to: (a) building up the capabilities of their development personnel, particularly at the local and regional levels, for effectively performing the planning, decision making, and management functions decentralized to them; and (b) building up the capabilities for the collection, storage, processing, analysis, and retrieval of relevant data and information for planning and implementation of plans. The present paper relates to challenges being faced by the developing countries in the latter context, viz., data and information needs for planning.

TRENDS TOWARDS MULTILEVEL PLANNING

The changes in the orientation and structure of development planning have led the developing countries to adopt "multilevel planning" in various forms. Despite variations, some common developmental and administrative changes noticed in these countries are: an increasing shift towards decentralization; promotion of local government institutions; delegation of functions and powers to such institutions; and increased transfer of central resources to lower levels. For example, in India, a "staged approach" to decentralized district planning has become one of the important strategies of the Seventh Plan (1985-90). In Bangladesh, decentralized Upazila (upgraded *thana*) planning has assumed great importance since 1983. In Nepal, a new Decentralization Act of 1983, seeking to establish a unified development administration at district levels under a political executive is under active implementation. In Sri Lanka, the scope for district and local-level decision making and investment allocation has been augmented through the appointment of district political authorities and district ministers (since 1980), the establishment of a decentralized district budget, and the creation of District Development Councils and Gramodaya Mandalayas at local levels and their involvement in the preparation of local-level and subdistrict level plans. In Indonesia, the necessary structures for decentralized planning have been created, but the capabilities for an effective multilevel planning process are yet to be developed. In the Philippines, a regionalization strategy is being followed and the Regional Development Councils are being strengthened.

Among the African countries, in Kenya, a district focus for rural development has been employed since 1983. In Ethiopia, the principles of democratic centralism continue to guide multilevel planning, comprised of various layers, the Worida councils (at the subdistrict level), the Awraja councils (at the district level), and the National Committee for Central Planning (at the national level). In Uganda, although district teams and planning committees exist, they perform only some deconcentrated administrative functions and have not emerged into decentralized planning institutions. In Gambia, there have recently been trends towards regional development planning.

CHANGING DATA AND INFORMATION NEEDS

In the countries of the Near East, there is an increasing trend towards regional decentralization and responsibilities for planning and decision making are shifting to the second tier of administration.

In Latin America, there is little hard evidence of shifts towards greater local autonomy and local-level planning in recent years, although Mexico has had a general policy of decentralization commencing from the late 1970s.

THE IMPLICATIONS OF MULTILEVEL PLANNING: CHALLENGES AND METHODS OF MEETING THEM

The increasing trends towards decentralization cited from country experiences above, have immense implications insofar as data and information needs for planning are concerned. The following implications may be particularly noted:

(1) The changes in the orientation of planning have necessitated the building up of strong data bases touching on poverty, unemployment, and standards of living at the disaggregated level of the rural household. This means that data and information are now needed on a large number of micro variables, either on a universal basis or on a large sampling frame basis. The integrated rural development programmes and other employment generation programmes that are being implemented at the grass roots level in many countries today call for highly disaggregated data and information on crucial aspects of development touching on the beneficiaries at the village and farm levels.

(2) As multilevel planning has been introduced in the countries, data and information are now needed at different spatial levels of aggregation. This means that data and information are now to be collected at the smallest unit area level and then communicated to the various administrative levels in the hierarchy for aggregation and further processing according to needs.

(3) As the levels of planning have increased, so has the magnitude of data to be handled at the different levels of aggregation and disaggregation and also the range and intensity of analysis.

(4) Multilevel planning has also introduced a time constraint, as planning has to be simultaneously undertaken at the different levels and then integrated through an iterative process. This implies that the collection, processing, and

analysis of data and information have to proceed as expeditiously as possible to fit into the time frame envisaged for the planning process.

(5) Multilevel planning also entails considerable "flows" of data and information between and among the different levels. This means not only that data and information must be generated as quickly as possible, but also that they should be transmitted as early as possible. Each area level in a multilevel planning framework has to act as a bridge in the vertical transmission of information, both upwards and downwards. At the same time, the horizontal coordination of the activities of the multiple agencies operating at the intermediate and local levels is an important function which requires additional categories of information and the institution of procedures, meetings, and reports, which will ensure their transmission, receipt, and incorporation in decisions about future actions. In order to organize the necessary "flows" of data and information required of this framework in a systematic manner, the design and functioning of data and information networks have to be arranged by establishing suitable "information structures." Such organizational arrangements have to match the "authority structures" in a multilevel planning framework which are evolving in the developing countries.[3]

The above challenges have to be met by:

(a) Proper identification of data and information needs for different levels and stages (or phases) of planning;

(b) Instituting suitable arrangements for data collection, as well as the storage, processing, analysis, and retrieval of such data;

(c) Establishing suitable "information structures" to match "authority structures";

(d) Computerization of data and information and organizing the same in a network;

(e) Use of microcomputers at the local and regional levels; and

(f) Instituting training programmes for the various categories of development personnel such as the system designers, survey and data collection specialists, and policy planners and decision makers for the effective establishment and use of information systems.

CHANGING DATA AND INFORMATION NEEDS

The above "six steps" may sound like a tall order for the developing countries, which face serious financial, technical, and personnel constraints. Taking these constraints into account, a "modular and staged approach" towards these steps is advocated. This idea will be further elaborated later in this paper.

The objective of this paper is specifically to discuss the six steps mentioned above in the context of designing suitable information systems for food and agriculture decision making for the developing countries. It is emphasized in this context that such information systems should be:

(a) Effective and efficient in providing timely, relevant, accurate, accessible, and consistent information to food and agriculture decision makers;

(b) Able to adapt structurally and conceptually to changing conditions and to an evolving policy agenda, thus avoiding conceptual and institutional obsolescence; and

(c) Consistent with the human, financial, and institutional capabilities of the country as those capabilities develop and grow over time.4/

THE EVOLUTION OF AGRICULTURAL PLANNING AND POLICY

The evolution of agricultural planning and policy in the developing countries provides an understanding of the content, scope, and orientation of the many changes that have been undergone by the developing countries, the changing perceptions of the dynamics of development, and the changing international economic situation. This discussion provides the setting for grasping the directions in which the enormous needs for data and information have grown recently in the developing countries.

In the 1950s, the emphasis in agricultural planning was often on aggregate economic growth. The dominant development strategy favoured concentration of resources in industry, infrastructure, and exports. Excluding major irrigation works, plan outlays for agriculture were generally small and covered such operational activities as extension, crop-spraying programmes, veterinary services, and farmer cooperatives. Local participation and improved technologies were sometimes encouraged as part of the attempt to mobilize community resources for rural development but, in general, emphasis was on top-down, control-oriented approaches. Few agricultural planners were in key roles, accurate facts about agriculture and rural populations were hard to come by, and planning was largely fragmented.

By the middle of the 1960s, it became increasingly apparent that problems of economic growth, unemployment, and poverty were not going to be adequately solved unless agriculture was given its due place in development strategy. Though preoccupation with growth strategies continued, agriculture was accorded high priority in a number of developing countries, particularly in Asia where food deficits had become almost chronic. Vigorous programmes were mounted to provide package inputs associated with the "Green Revolution" (e.g., seeds, water, fertilizer, credit, and marketing) and often at subsidized prices. As expected, substantial increases in food production were recorded in those years. Yet, as impressive as the gains were, they were confined to relatively better endowed areas and, even there, brought into sharper focus the disparity in the distribution of benefits among different classes of farmers. The problems of unemployment, poverty, and malnutrition showed little signs of amelioration, and the high rates of population growth added to the dilemma of growth with poverty.

In short, the development strategies pursued in the 1950s and 1960s not only failed to establish a base for sustained and self-reliant economic growth but, in many cases, they also reinforced the "dual economies" and strengthened the forces responsible for perpetuating poverty and marginalizing disadvantaged groups.

These developments contributed to a food crisis in the early 1970s, and the direction of development policy shifted drastically from a predominant concern with promoting aggregate economic growth through large-scale industrialization, physical infrastructure, and exports, to policies of stimulating internal demand, developing human resources, and reducing disparities in income and wealth. The new policies were concerned as much with the distribution of benefits as with the rate of economic growth. Accordingly, more emphasis was placed on programmes aimed at improving the lives of the majority of the people in areas such as food production, rural development, nutritional improvement, health, and educational services.

The limitations of top-down, control-oriented approaches to development planning were recognized more fully and a greater role was accorded to small-scale, multipurpose, integrated, replicable projects designed to benefit the poorest groups. The need for inputs from the grass roots in programme formulation and implementation was reflected in a renewed emphasis on local-level participation and the involvement of local self-governing bodies. The international assistance agencies also modified their aid strategies by placing greater emphasis on technologi-

129

cal, knowledge-based resource transfers and adjusting financial assistance to meet "critical" development problems. Structural adjustment issues also surfaced during this period.

Ironically, just when the new perceptions of development policy became widely accepted by the early 1980s, changes in the international economic situation seemed to threaten their successful implementation. The developing countries have had to increasingly divert their attention to structural adjustment policies to cope better with severe international recession and inflation, declining demand for their exports, rising prices of imports, and high interest rates. Debt servicing rose to unprecedented levels in many developing countries, placing strains on already meagre development resources and threatening the survival of many of the programmes and projects that had begun during the late 1970s. International capital flows to developing countries decreased sharply at a time when the need for additional resources was becoming more urgent.

In response to the growing complexity of development problems in the 1980s, the developing countries have sought to reorient their strategies. There is increasing concern with promoting self-reliance, expanding employment opportunities, agricultural and rural development, small-scale industrialization, human resource development, and spreading the benefits of development to lagging regions. There is sharper focus on "problem-solving," adjunctive sectoral planning, and policy actions that can help overcome specific constraints and problems. Agricultural and rural development are receiving higher priority, more resources are being allocated for increasing the productivity and income of small farmers, and most critical of all, new rural institutions and organizations are being created that will provide better access to resources by the poor in rural areas. There is greater flexibility and innovativeness in programme planning and implementation, monitoring, and evaluation of agricultural and rural development projects, which permit readjustment of the original project design during implementation. Multilevel planning approaches are being encouraged to create an economic and political environment that is more conducive to widespread participation to improve resource utilization. Much more attention is being given to: (a) alternative means of decentralizing authority; (b) responsibility and resources for planning and programming from central government ministries through field administration; (c) delegation of functions to regional, special-purpose, or functional authorities; and (d) devolution of functions to local governments.

CHANGING DATA AND INFORMATION NEEDS

DEMAND FOR INFORMATION AND THE DEVELOPMENT OF TECHNOLOGY

The foregoing account of the changing scenario of agricultural development in the developing countries emphasizes the point that the need for data and information at disaggregated levels has grown with greater emphasis on micro-level planning, and along with it numerous information-intensive activities. Moreover, the need for some extremely specialized and specific information in relation to the development strategy adopted has become imperative and urgent. While the information-provision activity in the developing countries has yet to respond fully to the varying perceptions of development planning and the different strategies introduced from time to time, there is no doubt that a lot of fresh data and information are now being generated in the cdeveloping countries through resource and socioeconomic surveys. Further, the application of sophisticated techniques like remote sensing has also helped to quickly update natural resource inventories. With these developments, the increases in the variety and volume of territorial data (topographic, administrative, environmental, demographic, socioeconomic, and other data) being generated today in any country have become quite appreciable. Particularly with the growth of information-intensive activities at the grass roots level, the data handling problems have become enormous. Against these changes on the development planning front, one has to see the tremendous development leaps that have taken place in the field of information technology, based on the multiple application of microtechnology and optical electronics, which have placed at our disposal tools that can quickly collect, store, process, and transfer data and information of all kinds. The problem before the developing countries now is to match these two developments (i.e., user needs and development of technology) and to benefit through the innovative approaches to data and information handling.

MAJOR ELEMENTS IN A CONCEPTUAL FRAMEWORK FOR ESTABLISHING INFORMATION SYSTEMS FOR MULTILEVEL PLANNING IN THE AGRICULTURAL SECTOR

The design and implementation of information systems oriented to food and agricultural planning and decision making must be informed by certain important considerations, which constitute the conceptual framework for our discussions.

The major elements of this conceptual framework are discussed below:

(1) The domain of food and agriculture encompasses the complex interactions of physical, climatic, biological, economic,

and social processes in the production, processing, distribution, and utilization of food and agricultural commodities. These processes are carried out under given climatic conditions and soil and water resource endowments, by governments, households, and production units.

(2) The national policy goals which are relevant to agricultural developmental planning are: (a) "growth," which includes the efficient allocation of existing resources in food and agricultural production and investment for improving the productivity of those resources and creating additional resources; (b) "equity," which encompasses the distribution among nations, groups within nations, and individuals within groups, of agricultural resources, products, and income; and (c) "stability," which adds a time dimension to the other two goals in terms of reducing year-to-year fluctuations along the time path of progress towards their attainment.5/

(3) Agricultural development is an immensely complicated business. The data and information required for agricultural planning must be informed by what can be called "multiperspectives." These include information governed by multiple goals and which is multidisciplinary, multidimensional, multitemporal, and intertemporal. Specialists with expertise in a single discipline, working alone, whether statisticians, economists, or others, are not sufficient for tailoring information for a specific decision situation. Data, theories, and methodologies from many disciplines are needed as ingredients to a particular decision. For food and agricultural planning, appropriate multidisciplinary information may be drawn from economics and other social sciences, biological sciences, statistics, and engineering, depending on the problem at hand.

The interdependencies and complexities of the domain of food and agriculture and its relationship to other domains of human existence create a demand for information disaggregated along several dimensions, e.g., by economic sector, geographic area, income class, rural-urban population, age, sex cohort, and commodity. Thus, a multidimensional perspective is called for.

Impacts of a decision taken today will be felt over several future time periods. Therefore, when making a decision, a multitemporal perspective must be brought into consideration. This means that it is important to consider impacts at several points in time. Similarly intertemporal considerations are also necessary. This means that it is important to consider cause and effect linkages between time periods.

(4) In the multilevel planning context, there is not one, but several information users and often several distinct needs. This is an important characteristic which distinguishes multilevel planning from the traditional process of planning. In the traditional process of planning (which has now been rejected), the planners prepare various options, based on the data and information available, in which they present the decision makers with the various alternatives and all the costs and benefits involved. The decision maker, who may be in public administration or government, then chooses the various possible options. In a multilevel planning framework, on the other hand, the "decision makers" are a pluralistic entity; they are not only people in public administration or government, but also various others concerned with the decision making process; i.e., political groups, interest groups, and social groups, and what leads to development is usually not the result of a decision in the classical sense, but of negotiations between concerned parties. This means that in a multilevel planning context, it is necessary to consider the data and information needs of a number of groups, who have varied interests. Naturally, the designing of information systems in a multilevel planning context is more complex.

(5) In multilevel planning, decision making can be viewed as a continuous, cyclic process of identifying problems, formulating alternative solutions, analysing options, making decisions, implementing decisions, observing the results, evaluating the situations, and then continuing to deal with new or ongoing problems. Information is used in all stages, and the process is iterative, in that some stages may be repeated based on information gained at later stages. The potential roles of data and information may be listed as follows:

(a) as a tool for problem definition, measurement, and analysis;

(b) as a tool for inventory-taking and decision making;

(c) as a tool for the evaluation of the programmes, project results, facts, and impacts; and

(d) as a means of orienting planning to people's perspectives and not merely to the planners' perspectives.6/

The data and information needs for each of the abovementioned roles would differ.

(6) Data and information needs would vary for the different planning stages and phases and for every type of development activity (table 4.1). These stages and phases and broad information requirements can be generalized as follows:

TABLE 4.1. PLANNING STAGES, PHASES, AND INFORMATION REQUIREMENTS

Planning Stage	Planning Phase	Information Requirements
I. Pre-planning (diagnosis)	a) The inventory phase b) Formulation of development strategy and definition of goals (targets)	Broad magnitudes and aggregates relating to the state of the local and regional economy; natural and human resources information and other socioeconomic information
II. Planning (prognosis and programmes)	c) Prognostication phase (changes in the present situation for various sectors, i.e., a set of forecasts or anticipated developments)	Policy changes envisaged and information pertaining to factors promoting or retarding development
	d) Programme/ project identification/ appraisal/ formulation phase	Detailed project-specific, scientific, and technical information, including costs and benefits
III. Implementation planning	e) Monitoring/ evaluation/ control phase	Constraints and problems encountered during implementation; effects and impacts of programmes/ projects

(7) The information needs in the context of multilevel planning will depend on:

  (a) the specific planning and decision making functions assigned to the different levels; and

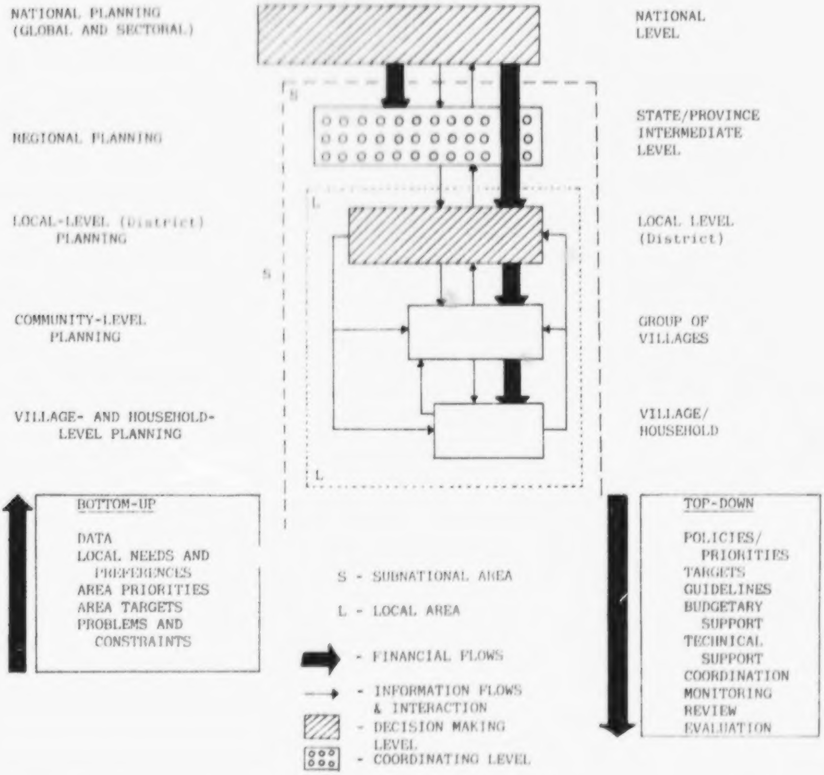
  (b) the problems of information exchange arising from the needs of economic and social planning.

(8) The area levels of decision making in a multilevel planning framework are chosen on the basis of the principles of function-sharing with reference to functionality (i.e., planning functions matched to their geographic scope), viability in terms of area and population, and administrative feasibility (i.e., availability of administrative and technical expertise and the existence of offices of line departments and agencies). Although the specific levels for any country may have to be suitably defined in the context of its existing administrative structure, for the purpose of this paper, a rational system of interdependent multilevel planning and decision making process with five distinct levels, i.e., national, regional, local, community, and household levels, has been assumed. The essence of the multilevel planning process is the intensity of flows (both financial and information flows) and interaction between and among the spatial levels. The top-down flows consist of financial allocations (budgetary support) and information flows on plan priorities, targets, and other technical information and guidelines for planning, coordination, monitoring, review, and evaluation. The bottom-up flows consist of statistical data and information on local needs and performances, area priorities, area targets, problems, and constraints. A hypothetical multilevel planning system is illustrated in figure 14. Broadly and illustratively, the planning functions at the five levels are indicated in table 4.2.

DATA AND INFORMATION REQUIREMENTS FOR AGRICULTURAL DEVELOPMENT IN A MULTILEVEL PLANNING SYSTEM

There are several different approaches for deriving data and information needs for development planning. Two major approaches are discussed in this paper. These may be called: (a) the goals/policy areas approach; and (b) the planning techniques approach. In the first approach, the goals, subgoals, and policy areas and instruments are derived from the national to the project level and then the data and information needs are specified. In the second approach, the techniques of analyses that are nec-

Figure 14. A Hypothetical Multilevel Planning System Showing Levels, Flows, and Interaction


NATIONAL PLANNING
(GLOBAL AND SECTORAL)
NATIONAL LEVEL
REGIONAL PLANNING
STATE/PROVINCE INTERMEDIATE LEVEL
LOCAL-LEVEL (District) PLANNING
LOCAL LEVEL (District)
COMMUNITY-LEVEL PLANNING
GROUP OF VILLAGES
VILLAGE- AND HOUSEHOLD-LEVEL PLANNING
VILLAGE/ HOUSEHOLD
S
L
S
L
BOTTOM-UP
DATA
LOCAL NEEDS AND PREFERENCES
AREA PRIORITIES
AREA TARGETS
PROBLEMS AND CONSTRAINTS
TOP-DOWN
POLICIES/ PRIORITIES
TARGETS
GUIDELINES
BUDGETARY SUPPORT
TECHNICAL SUPPORT
COORDINATION
MONITORING
REVIEW
EVALUATION
S - SUBNATIONAL AREA
L - LOCAL AREA
- FINANCIAL FLOWS
- INFORMATION FLOWS & INTERACTION
- DECISION MAKING LEVEL
- COORDINATING LEVEL

Notes: (i) Financial allocation directly flows from the national level to the local level, bypassing the intermediate level.

(ii) Within the local area level, the interactions between district, community, and village/household levels are in all directions.

essary for agricultural developmental planning at different levels are first determined and then their data and information requirements are derived. We may illustrate both of these approaches with some examples.

TABLE 4.2. PLANNING FUNCTIONS AT DIFFERENT HIERARCHICAL LEVELS (ILLUSTRATIVE)

Spatial Levels	Planning functions
National	(a) Formulation of national development strategy and policy; setting of goals, priorities, and targets; (b) mobilization and allocation of financial resources, including financial transfers to subnational level units; (c) drawing up of national plans and intersectoral allocations and deriving the criteria and guidelines for planning at the subnational levels; (d) fixing sectoral targets and macro policies for the development of each sector/region; (e) formulation of trade policies and fixing of export targets for relevant commodities; (f) prices and incomes policy; (g) distribution of food and essential articles of consumption; (h) fixing of priorities and allocations of funds for special programmes for poverty eradication and people's participation and assigning the weights to be given to equity aspects and for the formulation of special regional development programmes; and (i) evaluation of plans, programmes, and projects.
Regional	(a) Preparation of comprehensive regional plan; (b) preparation of specific-purpose regional plans; (c) integration of local-level plans (interlocal planning and provision of linkages); (d) integration of local-level and national plans; (e) preparation of programmes and projects in the region's sphere of responsibility, e.g., medium industries; medium irrigation; regional experimental farms; survey and research; regional roads; and energy projects; (f) data feeding to the national level; (g) drawing up guidelines for planning at the subregional levels; and (h) monitoring and evaluation of plans, programmes, and projects at the regional level.
Local	(a) Preparation of local-level plans for subjects falling in the local area's sphere of responsibility, e.g., agriculture and allied activities; minor irrigation; small-scale and

TABLE 4.2. (continued)

Spatial Levels	Planning functions
	cottage industries; rural public works; community development activities; health, family planning, and nutrition; schools; basic minimum needs such as drinking water supply, housing, sanitation, access roads, and social welfare programmes; (b) estimation of local production targets for the productive sectors of the economy; (c) identification of credit needs and credit planning; (d) organizing various kinds of agri-support activities, e.g., markets for farm products; (e) organizing extension services; (f) training of local youth and upgrading the skills of local population; (g) locational planning for production activities and for provision of economic infrastructure and social services; (h) antipoverty planning for households of the rural poor; (i) monitoring of plans, programmes, and projects; and (j) data collection and data feeding to the higher levels.
Community and household	(a) Preparation of community development projects emphasizing the needs of the community; (b) preparation of household level plans, identifying projects, and incorporating credit needs; (c) developing the receiving system at the grass roots level; (d) organizing (i) village surveys, and (ii) household surveys for generating relevant farm management data and community-level statistics; (e) planning extension services and training farmers in the application of new technologies; (f) training of local youth and upgrading of local skills; (g) monitoring; and (h) data collection and data feeding to higher levels.

Goals/Policy Areas Approach

The broad goals of food and agricultural decision making were identified as growth, equity, and stability. Examples of typical information associated with each of the three general goals are broadly identified as follows:

(a) Growth: Agricultural production and value added, labour efficiency, crop yields, rate of return on investment, meat or milk yield, cost of feed, cost of food, and input costs;

(b) Equity: Farm/nonfarm income ratio, nutritional status of socioeconomic groups, size distribution of landholdings and income, unemployment ratio, and cost of agricultural subsidies; and

(c) Stability: Year-to-year fluctuations in grain production, livestock production, food prices and income, measured with, for example, means and standard deviations or frequencies and amplitudes.

The above is a very broad generalization, which does not specify the details. More detailed and precise data and information needs can be spelled out only in the context of a particular country's development orientation, objectives, strategy, planning system, and related decentralization policy, actual degree and stage of national development, as well as the particular planning phase being dealt with (i.e., pre-planning, planning, or post-planning). However, by way of illustration, some major data and information needs at the national, regional, local, community, and household levels are indicated in table 4.3.7/

We may now illustrate how data and information can be derived by considering a specific policy intervention, viz., improving food and nutrition. The method is first to break down the policy goal into relevant policy instruments. These policy instruments can be organized hierarchically into those that have to be considered at the formulation (higher) level, programme implementation (middle) level, and project implementation (lower) level. Figure 15 illustrates how this can be done. For example, three alternative ways of improving food and nutrition have been indicated, viz., increasing the food supply; influencing the per capita demand for food; and decreasing the population growth rate.

Alternative ways of achieving each of these instrumental objectives are identified next, and so on moving further to the right, until more narrowly focused policy instruments, e.g., at the project level, are reached. For the planning of each programme/project, the relevant data and information variables are then identified in figure 15 and appendix 1, showing "General Classification of Food and Agricultural Information."

TABLE 4.3. DATA AND INFORMATION NEEDS AT MULTILEVELS

Spatial Level	Data and information requirements
National	Macro (aggregated) information as well as some essential regional data. This will include area/land-use statistics; agricultural and rural sector employment; inflation levels, income, and wage rates; savings and investments; crop production; agricultural prices; agricultural imports and exports; data on input and factor utilization; supply and prices; data for supply analysis such as elasticities; prices and production patterns and levels; data for demand analysis such as agricultural factors/input as well as production (value added or otherwise); and data on external trade; balance of payments and exchange rates; broad demographic profile of the rural and urban population.
Regional	Regional macroeconomic indicators such as unemployment rates, wages, income distribution, and per capita income; savings and investment pattern; sectoral data on production, exports, and imports of the agricultural sector, cottage and small-scale industries and agribusinesses; information on regional physical profile and resources and constraints; data on agricultural land availability and utilization (by different commodities and subsectors); characteristics of landholdings, livestock, rural services and infrastructure, and use of inputs; data on education, health, nutrition, and housing facilities; data on specific regional problems; and broad regional development indicators, e.g., output indicators, economic indicators, technological indicators, and quality of life indicators.
Local	Data on natural, human, institutional, and infrastructural resources at the local level; local constraints and limitations for development; detailed sectoral data such as land tenure system, level of farm fragmentation and size of holdings, cropping patterns, agricultural labour and farmers' wages and income, productivity and consumption patterns; and

TABLE 4.3. (continued)

Spatial Level	Data and information requirements
	economic and market data (costs, prices, returns, subsidies, and taxes) regarding sectoral outputs and inputs for performing cost-benefit and feasibility analyses; technical and operational information required for project formulation and implementation.
Community & household	Data on socioeconomic profile of the community; information on basic agricultural, livestock, fisheries, small-scale and cottage industries; agricultural ownership patterns, local demand for produce, farm gate prices and input costs; employment levels, wages/income, consumption and literacy rates; information on various support services and infrastructures; and basic farm management data, including farmers' behaviour.

Planning Techniques-Oriented Approach

In this approach, firstly the kind of analyses to be performed for agricultural development planning in a particular country context for various levels of planning (national, regional, and local) are decided upon. This will be determined by the nature of planning skills available in a country, its stage of development, and the country's policy in regard to decentralization of planning. The data requirements will also depend on the degree of sophistication in the planning techniques proposed to be adopted. In a country with less planning skills and in the early stages of planning evolution, the data and information requirements will be modest; but they would tend to increase, as more and more planning capabilities are built up and improved planning techniques are adopted. Thus, the kind of analyses to be conducted for agricultural development planning could be envisaged under different options, ranging from a somewhat crude and conventional approach to a highly sophisticated one, with varying shades of sophistication in-between.

The requirements of various kinds of data, research, and analysis for agricultural development planning will become more meaningful if they are discussed within the framework of the agricultural development planning process. Broadly, the processes of agricultural planning comprise: (a) an analysis of the

Figure 15. Policy Areas and Information Relevant to Improved Food and Nutrition

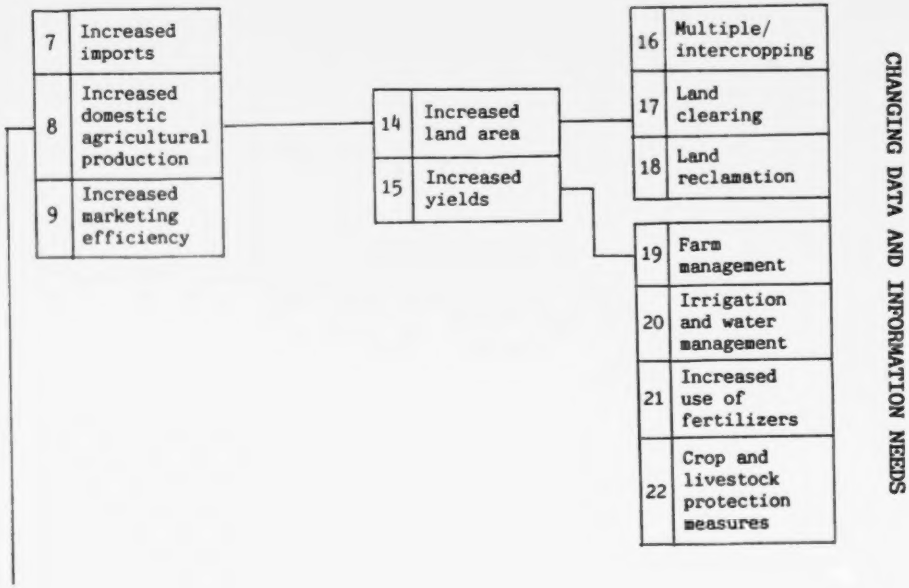
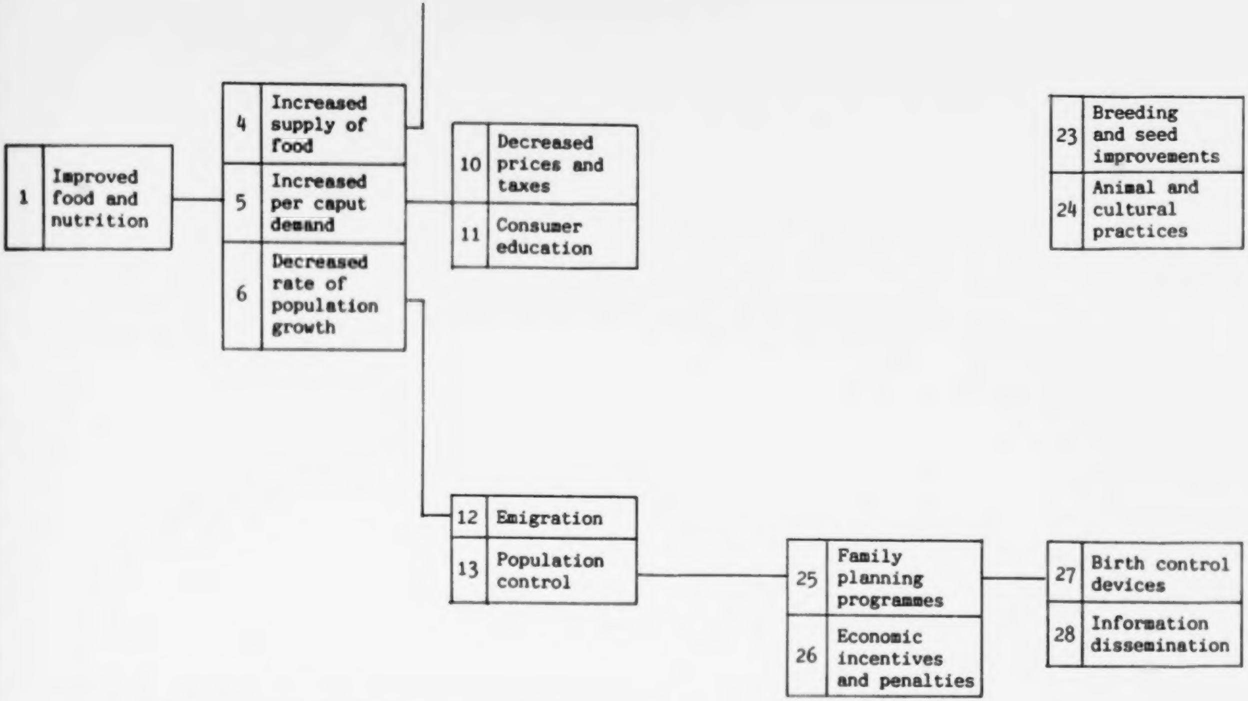

7 Increased imports
8 Increased domestic agricultural production
9 Increased marketing efficiency
14 Increased land area
15 Increased yields
16 Multiple/ intercropping
17 Land clearing
18 Land reclamation
19 Farm management
20 Irrigation and water management
21 Increased use of fertilizers
22 Crop and livestock protection measures
CHANGING DATA AND INFORMATION NEEDS

Figure 15. (continued)


1 Improved food and nutrition
4 Increased supply of food
5 Increased per caput demand
6 Decreased rate of population growth
10 Decreased prices and taxes
11 Consumer education
12 Emigration
13 Population control
23 Breeding and seed improvements
24 Animal and cultural practices
25 Family planning programmes
26 Economic incentives and penalties
27 Birth control devices
28 Information dissemination

Source: Adapted from Rossmiller and Johnson (1978).

role of agriculture in the economy; (b) formulating the goals of agricultural development consistent with the overall objectives of development; (c) estimating the demand for, and requirements of agricultural commodities; (d) projection of production; (e) choice of programmes, projects, and measures; (f) establishing balance and consistency of the agricultural programmes within the overall plan; (g) implementation of the plan; and (h) evaluation of the plan. Appendix 2 broadly indicates the data and studies needed in relation to different techniques of planning. As it is important to formulate the medium-term plan in the framework of a long-term perspective of the economy in general, and of agriculture in particular, perspective planning is an essential element of the planning process. Therefore, the requirements of data and research for perspective planning have also been included in appendix 2.

The listing of data and information needs is only indicative, and is not an attempt to specify all data which should be collected. It has also not been spelled out for the different spatial levels, in view of the fact that it will depend on different assumptions in regard to the extent of decentralization. The data and information requirements for agricultural development planning are too wide. Countries have to progress "in steps" with improvement in planning techniques. In this process, efforts should be made to fill in the gaps in accordance with a scheme of priorities.

ORGANIZING THE USE AND MANAGEMENT OF THE DATA BASE

The data generated at any particular spatial level is not meant to be used in isolation for the purpose of planning. The use of the data base becomes effective only when it is appropriately linked to the planning activity at the different levels. This would require the establishment of organization and communication linkages among different hierarchical levels so as to facilitate reciprocal interaction and exchange of information. The efficacy of multilevel planning would ultimately depend upon how effectively the data and information flows are arranged between and among the different levels.

In order to organize the required data and information to serve all levels of planning and ensure their compatibility and quality, a two-pronged approach is suggested, as follows:

(a) Organizing "reporting structures" at the project level which will serve as continuous mechanisms to provide the identified gaps in data and information according to planning needs; and

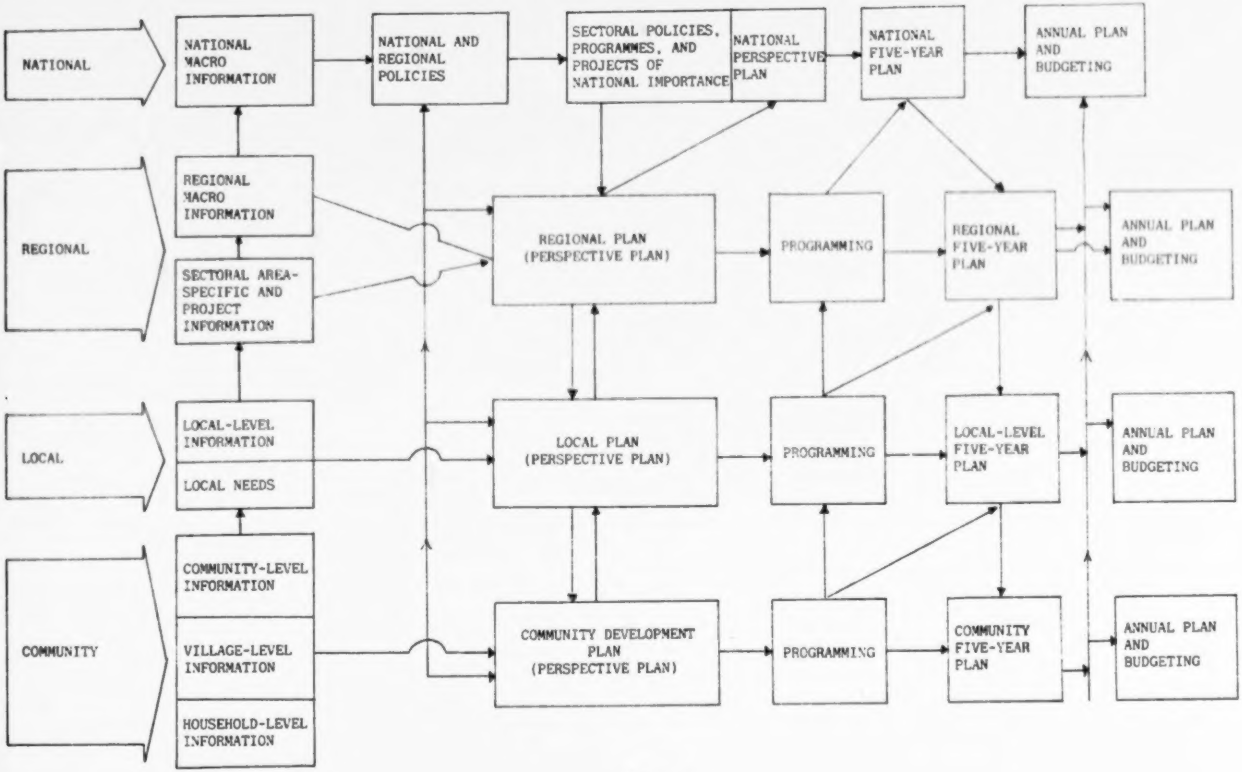
(b) Setting up an organization at each chosen level for planning which will be in the nature of a "receiving mechanism" for all data and information generated at the particular area level. It will sift the data and information received from reporting agencies and present them to the user-agencies at various levels according to their needs.

Thus, for the multilevel planning process discussed in this paper, apart from the reporting structures which will be in the nature of feeding mechanisms, an organizational set up at different levels, i.e., from the central government to the local community, will also be needed. Without this structure, the data supplied by the local reporting units can never be assembled and processed quickly and according to needs.

A method of structuring the flow of information in a multilevel planning system is shown in figure 16. In this hypothetical system, four decision making levels (national, regional, local, and community), a centralized budgetary system, and plan formulation for three time horizons -- long-, medium-, and short-term -- have been assumed. An effective two-way process of communication is necessary to firm up realistic national and regional policies and annual planning and budgeting process at the national and other levels. This is indicated by the thick lines which interlink all the levels. In this way, the national policy will be informed by local and regional needs and at the same time will help in shaping and working out schemes and projects at the local and regional levels in conformity with the national priorities. Also, the annual planning and budgeting processes at the various levels are rendered mutually consistent. The planning bodies at each level interact vigorously to exchange relevant information for the preparation of the Perspective, Five-Year, and Annual plans. The programming activity meaningfully guides the planning activity designed for the next time horizon at the different levels. If the information flows can be designed in this manner, a complementing relationship among the various plans worked out by the different levels can be effectively realized in practice.

In the multilevel organizational set up proposed here, it is assumed that "information structures" at the various levels will be built up in conjunction with the organizational structures for planning. It is necessary to clarify the point that the "information structures" proposed here are different from "information collection agencies," which, in most countries, are connected with the different subject matter departments. While the latter will continue to play their role as primary data collection agencies, the "information structures" proposed here to function in conjunction with the "planning organizations," are meant for

Figure 16. A Multilevel Planning System


NATIONAL
NATIONAL MACRO INFORMATION
NATIONAL AND REGIONAL POLICIES
SECTORAL POLICIES, PROGRAMMES, AND PROJECTS OF NATIONAL IMPORTANCE
NATIONAL PERSPECTIVE PLAN
NATIONAL FIVE-YEAR PLAN
ANNUAL PLAN AND BUDGETING
REGIONAL
REGIONAL MACRO INFORMATION
SECTORAL AREA-SPECIFIC AND PROJECT INFORMATION
REGIONAL PLAN (PERSPECTIVE PLAN)
PROGRAMMING
REGIONAL FIVE-YEAR PLAN
ANNUAL PLAN AND BUDGETING
LOCAL
LOCAL-LEVEL INFORMATION
LOCAL NEEDS
LOCAL PLAN (PERSPECTIVE PLAN)
PROGRAMMING
LOCAL-LEVEL FIVE-YEAR PLAN
ANNUAL PLAN AND BUDGETING
COMMUNITY
COMMUNITY-LEVEL INFORMATION
VILLAGE-LEVEL INFORMATION
HOUSEHOLD-LEVEL INFORMATION
COMMUNITY DEVELOPMENT PLAN (PERSPECTIVE PLAN)
PROGRAMMING
COMMUNITY FIVE-YEAR PLAN
ANNUAL PLAN AND BUDGETING

assembling, verifying, and collating the data and information, and processing the same for planning purposes. In this context, the linkages that are necessary between the "information collection agencies" and the "information structures" at the planning levels, as well as the linkages between and among the different planning levels can be effected either manually or by automation.

ESTABLISHING INFORMATION SYSTEMS FOR AGRICULTURAL DEVELOPMENT PLANNING: THE APPROACH

In the previous sections of this paper, we discussed the role of data and information in agricultural development planning and also pointed to some approaches to the problem of deriving the data and information needs for such type of planning. Before concluding this paper, it would be appropriate to make some brief observations as to what the present discussion implies in terms of establishing appropriate information systems for multilevel planning for the agricultural sector. We will first make some general observations and then end with more specific ideas on information systems for planning for the agricultural sector.

It is necessary to emphasize, in the first instance, that all information systems are purposive. No single information system is appropriate for all planning purposes. We should, therefore, start with identifying the various programme or project segments and their objectives. Information systems should then be designed to meet those objectives. In a multilevel planning context, comprehensive planning envisaged at each distinct spatial level makes the problem very complex. Perhaps, here we can envisage the development of information systems in two specific contexts. The first is the development of a nonspecialized general-purpose system, which could be utilized by a heterogeneous group of users concerned with policymaking and planning. Such a general-purpose system could handle the planning tasks of diagnosis, i.e., problem identification, and macro-framework building for the plan, which are the initial steps in the formulation of any plan.

The second context is the more specific programme or project formulation desired during the action phase. Here the development of specialized information systems is called for, oriented to the individual programme or project requirements.

By breaking the planning tasks and assigning priorities in this manner, it would be possible to proceed with the establishment of information systems in a modular way, i.e., staged in steps. Such an approach would be the best for the developing countries. It will enable the:

(a) Smooth transition from existing to new technology;

(b) Optimum utilization of existing equipment and skills;

(c) Possibilities of upgrading equipment in case of growing demand;

(d) Wide diversity of outputs to meet all types of needs; and

(e) Possibility of step-by-step progress in establishing equipment to allow for staggered investments and training.

DEVELOPMENT OF COMPUTER-BASED INFORMATION SYSTEMS FOR PLANNING: PROBLEMS AND PROSPECTS

It must be admitted that modern information technology has been slow in finding use and application in the governmental tasks of planning and decision making in the developing countries.

> What has been achieved in most cases, are incomplete inventories of baseline data about economic, social, cultural, political, and physical features of the environment, and the automation of routine, record keeping applications, primarily in finance and revenue-maximizing services. Experiments or endeavours towards urban or regional planning information systems are very recent and still evolving.8/

The slow adoption of modern technology has been partly attributed to the cost and user limitations in handling information through mainframe computers. With large, centralized computer and communication systems, users typically must obtain the products they require with the assistance of professionals (programmers and systems analysts), but these arguments are no longer valid. With the advent of microcomputers, which are "user-friendly," these relationships have changed.

> The growth of microcomputers is putting tremendous computing power into the hands of end-users (those who actually apply the technology in their daily work), who may require limited support from data processing professionals. Some microcomputers available today have power comparable to mainframes developed five years ago, yet end-users can essentially teach themselves to use powerful software packages.9/

CHANGING DATA AND INFORMATION NEEDS

Microcomputers have a revolutionary potential for subnational planning. With this innovation, the use of information technologies is becoming increasingly decentralized. It is now possible to promote local-level computerization at relatively little cost and with some effort by training the end-users.

Despite the cost reduction and the possibilities for decentralized use, the widespread application of microcomputers in the developing countries have to cope with a number of problems and challenges. First, there is managerial resistance to change, organizational rigidities, and the reliance on time-tested rules, procedures, and methods of work. Second, there is a lack of appropriate software and skills in systems analysis, which are needed because of the complex nature of the technology and the fundamental changes in the organizational processes that it will involve. Third, microcomputers require extended user learning before substantial gains can be obtained. These problems. common to all innovation processes, underline the fact that the rate of adoption will not depend on the reduction in the price of microcomputers, but rather on understanding their strategic significance.10/ In this context, it should be mentioned that the adoption of microcomputers has brought organizational and human resource issues to the fore, and the developing countries must first address themselves to these issues before adopting the new technology.

PREREQUISITES TO THE ADOPTION OF THE NEW TECHNOLOGY

In order to take advantage of the new possibilities and potentials afforded by the new information technology, it is necessary for any country adopting this technology to comply with the following prerequisites:

(a) Establishing a reliable collection of data at the sources and imparting knowledge as to how to feed these into the system;

(b) Installing microcomputers for performing specific planning and analytical tasks at various spatial levels and networking them with the mainframe computer, thus establishing a viable communications network in the country;

(c) Developing suitable software to handle the variety of planning problems;

(d) Building up a sound personnel base with experts conversant not only with the technical side of their equipment, but also with the methods of handling the vast volume of statistical material; and

(e) Rendering the top policy experts in government, i.e., in the ministries of finance and planning, knowledgeable about the potentials of the new information technology and information systems.

"MACHINE TRAINING" AND "MACHINE EDUCATION": AN INTEGRATED APPROACH TO TRAINING

In a multilevel planning system, the task will be to enrich the capacity of the information technology, so that the multitude of transactions occurring at a number of discrete points or area levels, where policymakers, planners, development analysts, and system designers may interface, is rendered purposeful, meaningful, and mutually beneficial. This demands an "integrated" approach to training, so that technical perfection in information technology is matched with the ability to use the system for improved decentralized planning and for providing effective feedback for innovative designing of systems. The integrated approach to training here is meant to impart relevant knowledge, skills, and attitudes to both designers and users, so that they become partners in a shared exploration of a system's capabilities. It should be noted that this implies both "machine training," i.e., teaching individuals the use of a specific piece of hardware and software, as well as "machine education," i.e., providing the necessary orientation about the capability of the information technology, so that the best use can be made of the products of the system.11/ Such training could be usefully organized through an "interactive method" in which all the target groups can be brought together for the maximization of net benefits. While some aspects of the training programme will be common to all, they may branch out for particular orientations after going through a common curriculum initially.12/

SUMMING UP

To sum up, the challenges involved in the transition to the adoption of the new technology are several and often complex and difficult for the developing countries. They include: identifying and appraising the information needs for different orientations in planning; the design of appropriate information systems; the development of software; the establishment of a computerization network; the establishment of suitable organizational structures in a multilevel planning framework; the attraction and selection of competent personnel to build, maintain, and run the computers and the communication network; and the training of users and designers through interactive methods for mutual good and for maximization of benefits. For achieving the above ends, a step-by-step approach is advocated. In this way, resources (both financial and human) could be applied to the best advantage. In this context, the evolution of the country policies and their accompanying support measures are not merely a matter of domestic concern, but also of international concern. International bodies can render assistance in a number of areas, such as the design and preparation of training courses, provision and exchange of experts for teaching, exchange of training material and new software developments, training of trainers, organizing promotional courses for specific countries which need such intervention, and post-training evaluation of results. International agencies can also provide catalytic assistance to establish and promote the training network in each country. They can especially provide appropriate networking tools to foster communication between users, such as the establishment of information dissemination centres and newsletters, and arrangement of periodic seminars and workshops.

NOTES

1/ G. Shabbir Cheema and Dennis A. Rondinelli, *Decentralization and Development* (New Delhi: Sage Publications, 1983).

2/ Food and Agriculture Organization of the United Nations, "Toward Improved Multilevel Planning for Agricultural and Rural Development in Asia and the Pacific" (FAO economic and social development paper 52) (Rome, 1986).

3/ K. V. Sundaram, "Data and Information Needs for Subnational Planning" (Keynote paper presented at the UNESCO Seminar on Information Systems for Subnational Development Planning, Visakhapatnam, India, 16-20 December 1985).

4/ FAO, "Food and Agricultural Statistics in the Context of a National Information System" (FAO statistical development series 1) (Rome, 1986).

5/ Ibid.

6/ Sundaram, "Data and Information Needs for Subnational Planning."

7/ Ibid.

8/ Hidehiko Sazanami, "Assessing the Context for Information Systems for Urban and Regional Planning in Developing Countries" in UNCRD, *Information Systems for Urban and Regional Planning: Asian and Pacific Perspectives* (Nagoya, 1986).

9/ David Moskovitz and David Mammen, "Information Technologies in Government: Organizational and Management Issues" in UNCRD, *Information Systems for Urban and Regional Planning: Asian and Pacific Perspectives* (Nagoya, 1986).

10/ Mukul Sanwal, "Microcomputers in District Administration: Need for a Policy Approach," *Economic and Political Weekly* 22 (28 February 1987).

11/ S. Barrett and S. Baddeley, "Information Needs for Local Authorities: Small is Beautiful" (Paper contributed to the Joint UDM-SORSA Symposium on Information Needs for Local Authorities, The Hague, 2-6 June 1985).

12/ K. V. Sundaram, "An Integrated Approach to Training for the Establishment and Use of Information Systems for Subnational Development Planning," *Regional Development Dialogue* 8 (Spring 1987).

APPENDIX 1. GENERAL CLASSIFICATION OF FOOD AND AGRICULTURAL INFORMATION

Description

Identification
- Holding, holder, respondent
  - Holding
  - Holder
  - Respondent for holding
- Household, head of household, respondent
  - Household
  - Head of household
  - Respondent for household
- Agricultural service establishments
- Locality
- Other units (to be specified)

General Characteristics
- Holding
  - Holder
  - Hired manager
  - Economic activities of an enterprise
- Agricultural service establishments
- Cooperatives

Demographic and Anthropometric Characteristics
- General information
  - Household
  - Household members
- Guests
- In-migration and out-migration
- Anthropometric characteristics of household members

Employment
- For each household member
  - Status of labour force participation
  - Occupation
  - Employment status
- Employment on holding
  - For each member of holder's household (including holder) -- for holdings whose holders are real persons
  - Agricultural workers, other than members of holder's household
- Employment in agricultural service establishments
  - Unpaid family workers
  - Permanent agricultural workers

APPENDIX 1. (continued)

Description
Cost of labour (for holdings and agricultural service establishments)
Wages paid
Cost of insurance and other fringe benefits
For each agricultural worker -- permanent and occasional (for holdings and agricultural service establishments)
Identification
Time worked
Wages earned
Participants in cooperatives, collectives, or communal holdings
Employment outside holding (for households of which at least one member is a holder)
For each member of household (including holder)
Land and Water
For entire holding
Number of parcels and total area
Rental of land
Land purchased or sold
Shifting cultivation
Use of soil conditioners
New cropland
New permanent meadows and pastures
Irrigation
Drainage
For each parcel
Location, area, and distance
Area by tenure
Rent
Land use
Irrigation and drainage
Shifting cultivation
Crops
For entire holding
Temporary crops
Permanent crops
Fertilizers
Pesticides
Seeds and young plants
Animal power
Machinery
Crop insurance

APPENDIX 1. (continued)

Description

- For each parcel
  - Crop stand
  - Temporary crops - rotation and intensity
  - Temporary crops - inputs used
  - Temporary crops - outputs
  - Permanent crops - plantation characteristics for each crop
  - Permanent crops - inputs used during year - nonproductive age
  - Permanent crops - inputs used during year - productive age
  - Permanent crops - outputs
  - Permanent crops - nurseries

Livestock

- Management and population
  - Livestock production system
  - Total number of livestock kept -- present population
- Cattle
  - Herd structure and management
  - Veterinary services
  - Feed
  - Labour
  - Other inputs
  - Production - meat
  - Production - milk
  - Production - other
- Buffaloes
  - (same as for cattle)
- Sheep
  - (same as for cattle)
  - Production - wool
  - Production - milk
  - Production - other
- Goats
  - (same as for cattle)
  - Production - goat hair
  - Production - milk
  - Production - other
- Pigs
  - (same as for cattle)
- Horses and camels
  - Horses
  - Camels
  - Sales and purchases during year

APPENDIX 1. (continued)

Description

- Chickens
  - Population
  - Inputs
  - Production
- Other poultry
  - Population
  - Inputs
  - Production
- Other domesticated animals
  - Bees
  - Others (including deer)

Machinery and Equipment

- For holdings
- Indication of use, by type of machinery and equipment
- Number used and source
- Rentals paid
- For holdings and agricultural service establishments
  - For machinery owned solely or jointly

Buildings and Other Structures

- Living quarters
  - General characteristics and agricultural use
  - Tenure
- Nonresidential buildings
  - Use and tenure
  - Physical properties of buildings
  - Purchases and sales
  - Construction costs during past year
- Other structures
  - Construction costs during past year

Ancillary Activities

- Forestry
  - Existence of forest trees on holding
  - Number of forest trees
  - Area under forest trees
  - Inputs used during year
  - Production during year
  - Sales
  - Own consumption
- Fisheries
  - Existence of fishery activities on holding
  - Cultural installation

APPENDIX 1. (continued)

Description

  - Inputs used during year
  - Production during year
  - Sales
  - Own consumption

Credit, Marketing, Stocks

- Credit
  - Credit activities
  - Credit received, for each transaction
- Marketing
  - Timeliness and sources of inputs
  - Disposal of products
- Stocks
  - Of agricultural products, by product
  - Of agricultural inputs, by input

Prices

- Prices received and prices paid by farmers
  - Prices received by farmers, by product sold
  - Wholesale prices, by product sold
  - Retail prices, by product sold
  - Export prices, by product exported
  - Prices paid by farmers at point of purchase
- Prices of household consumer goods and services
- World prices for agricultural products and inputs

Post-Harvest Foodgrain Losses

- At holding
  - Losses at harvest
  - Losses at threshing/shelling
  - Losses at cleaning/winnowing
  - Losses at drying
  - Losses in storage
  - Losses in transport
  - Losses in processing
  - Losses in packing and handling
- By intermediaries
- At warehouses

Income and Outlay

- Revenues not covered elsewhere
  - Rentals received
  - Receipts for agricultural services rendered
  - Other receipts

APPENDIX 1. (continued)

Description

- Outlays not covered elsewhere
- Income of household
  - From the holding
  - From the agricultural service establishment
  - From employment outside the holding
  - From other sources
- Sales of household property by household during past year
  - Sale of living quarters
  - Sale of secondhand durable household goods
- Miscellaneous household receipts
  - Inheritance
  - Other
- Household expenditures during past year, value, and quantity
  - Food, beverages, tobacco, and intoxicants
  - Fuel and light
  - Housing and household furnishings and services
  - Clothing and bedding
  - Miscellaneous expenditures
  - Savings

Other

- Foreign trade of agricultural inputs and products
  - Exports
  - Imports
  - Foreign exchange
- National accounts and budget
  - National accounts
  - Annual national budget
- Government land and water development and crop improvement projects
  - Total cost
  - Benefits
- Government-held stocks of agricultural products
- Domestic manufacturing
  - Agricultural inputs
  - Other manufacturing
- Climatic data, by region
- Community services available at village level
- Technological research information
- Quality of irrigation water
- Soil characteristics
- Agricultural extension
- Agricultural education
- Miscellaneous

APPENDIX 2. LIST OF BASIC DATA AND STUDIES REQUIRED FOR AGRICULTURAL DEVELOPMENT PLANNING

Planning Technique	Data and Studies Required	Source of Data and Type of Inquiry
(i) Analysis of role of agriculture in the economy	A) Population size and its breakdown into rural and urban and by economic activity	Population censuses and surveys
	B) Agricultural labour force	Manpower surveys
	C) Gross national product and its components. Production of food, raw materials, and livestock products	Compilation of national income accounts. Agricultural census. Current agricultural surveys, livestock surveys, and administrative records
	D) Export and import of agricultural commodities by quantity and value	Customs records
(ii) Goals of agricultural development	A) Establishment of objectives and targets	Public meetings and discussions, press articles, consultation with professional associations and parliamentary debates
	B) Reconciliation of objectives and targets	Plan frames, discussion in National Economic Council and/or Parliament
(iii) Demand projection: a) for food	A) Growth rate of population	Population censuses and surveys. Registration of births and deaths and emigration and immigration
	B) Urban and rural per capita food consumption levels	Food balance sheets. Household food consumption surveys

APPENDIX 2. (continued)

Planning Technique	Data and Studies Required	Source of Data and Type of Inquiry
	C) Income elasticity of demand	Time series of food consumption expenditures; family budget inquiries
	D) Price Elasticity of demand	Time series of quantities purchased and prices paid at retail and farm level. Household consumption and expenditure surveys
	E) Nutritional levels	Same as for (iii:B)
	F) Nutritional requirements	International tables on calorie requirements and recommended allowances or special nutritional standards studies
b) for wood	A) Wood consumption	*Ad hoc* wood consumption surveys
c) for raw materials	A) Value and quantity of raw materials. Value and quantity of output	Special surveys, statistical records
d) for export	A) Projection of world demand, supply, and trade in agricultural commodities	Studies made by international and national agencies
	B) Studies on national commodity situation and outlook	Current crop surveys. Records of crop arrivals in markets and/or surveys of market arrivals. Farm and wholesale prices. Stocks at end of year. Foreign trade statistics. *Ad hoc* inquiries on consumer preference and competitive position in foreign markets.

APPENDIX 2. (continued)

Planning Technique	Data and Studies Required	Source of Data and Type of Inquiry
		Cost of production surveys
(iv) Establishing production targets	A) Land utilization and land tenure	Government records. Agricultural census. Special studies
	B) Crop acreage and yield	Current crop surveys. Statistical records
	C) Simple input-output relationships	Controlled experiments conducted in selected areas, stations, and in cultivators' fields
	D) Production function	Time-series of production and estimates of input of factors like land, labour, and capital (fixed and working capital)
	E) Studies on the use of farm resources	Farm management sample surveys
	F) Studies on crop intensity, farm credit needs, marketing, price incentives, and agrarian reform	Case studies. Sample surveys. Agricultural bank reports
(v) Choice of programmes and projects	A) Information on actual and potential productivity of agricultural resources	Agricultural census, surveys, and experiments
	B) Capital-output ratio	Calculation of capital required for each project and of value of additional agricultural output from the project

APPENDIX 2. (continued)

Planning Technique	Data and Studies Required	Source of Data and Type of Inquiry
	C) Cost-benefit ratio	Calculation of cost (construction cost, operation and maintenance cost, and associated costs) for each project, estimation of its period of gestation, and calculation of amortization and interest charges. Evaluation of benefits from project -- information to be obtained on crops to be grown, their yields, production inputs, and their cost and estimation of future prices of crops and receipts from their sale
	D) Net balance of payment effect	Estimation of foreign exchange likely to be earned (or saved) by output from project in the plan period and of the foreign exchange content of fixed and working capital required for the project
	E) Employment effect	Estimation of additional employment resulting from the project and of the wage bill
	F) Socioeconomic effects	Estimation of nontangible benefits including the environmental effects such as erosion control, soil improvement, and wind protection obtained by afforestation
(vi) Reconciliation of agriculture sector	A) Commodity balance sheet	Estimation of availability and utilization of commodities for the base period and end of the plan

APPENDIX 2. (continued)

Planning Technique	Data and Studies Required	Source of Data and Type of Inquiry
	B) Resource budgeting	Estimation of supply of critical resources such as foreign exchange and skilled manpower, and the demand for them for the base period and end of the plan
	C) Input-output table	Preparation of sector account tables for the base period and end of the plan
(vii) Implementation of plan	A) Information on the efficiency of general administration	*Ad hoc* surveys
	B) Analysis of budgetary procedures	*Ad hoc* surveys
	C) Assessment and use of scarce technical and administrative personnel	Administrative and technical manpower surveys
(viii) Evaluation of plan	A) Financial evaluation	Analysis of public (central and local) expenditures, and the flow of of funds for development through the banking system
	B) Data on factor productivity	Case studies on estimating the productivity of land, labour, and capital in agriculture
	C) Project and programme evaluation	Analysis of periodical reports based on project record sheets
	D) Progress achieved in production and in provision of inputs	Current agricultural surveys

APPENDIX 2. (continued)

Planning Technique	Data and Studies Required	Source of Data and Type of Inquiry
	E) Impact on employment, wage level, and capital	Labour force surveys. Analysis of imports of agricultural machinery and changes in construction and capital goods on farms
	F) Public opinion on the successes or failures of the plan	Public opinion surveys
(ix) Perspective plan for agricultural development		
a) overall framework	A) Long-range growth rate of population	Same as for (iii:A) and assumptions regarding alternative rates of population growth
	B) Growth rate of national income	Same as for (i:C) projected for end of the perspective plan
	C) Information on available agricultural resources, including forestry and their actual and potential use	Structural and physical resource surveys and master plans. Forest inventories, including inventory of potential forest land through special surveys
b) long-range demand projections	A) same as for (iii) and (ix:a. A and B)	
c) long-range supply projections	A) same as for (iv) and (ix:a. C)	
d) assessment of requirements of agricultural inputs	A) Land use and production yardsticks	Agricultural censuses and surveys and experiments, especially those in the cultivators' fields

APPENDIX 2. (continued)

Planning Technique	Data and Studies Required	Source of Data and Type of Inquiry
e) assessment of requirements of trained manpower for agricultural development	A) Expected growth rate of agriculture and expected expansion of sectors within agriculture	Manpower studies and *ad hoc* inquiries

Source: FAO, "Statistics and Studies for Agricultural Development: A Phased Programme" (Agricultural planning studies, no. 1) (Rome, 1968).

PART II: COMPARATIVE CASE STUDIES OF INFORMATION SYSTEMS PROJECTS

5

"INFOTERRA": A GLOBAL ENVIRONMENTAL INFORMATION NETWORK

Sukehiro Gotoh

INTRODUCTION

Information is strictly a product of the human mind. It is intended to serve only Mankind and to be utilized for his learning and decision making for action. Along with materials and energy of a natural origin, information is one of the most useful resources for Mankind in the sense that it represents a compilation of our previous scientific knowledge and experiences. Information, therefore, should be shared and communicated among us all in an efficient manner for mutually beneficial human development.

There are two methods through which access to substantive information may be gained: One method is to try to locate the relevant information by directly searching for it, or close examination of indices of existing documented information. The other method requires, in principle, a two-step approach, i.e., to identify first the possible source(s) of information and then to obtain the relevant substantive information. In terms of library science, the former is called the document "reference" method, while the latter is called the source "referral" method. The referral process may thus need more time in which to obtain the substantive information, but is generally more reliable than the reference method in gaining access to more detailed and accurate information.

The purpose of this paper is to introduce a special type of information system, called "INFOTERRA," which was conceived and designed by the United Nations Environment Programme (UNEP), which is basically a referral system for identifying worldwide sources of information and, through the network thus formed, to promote exchange of information in the field of environmental management.

"INFOTERRA"

The author, as Director of National Focal Point "INFOTERRA" in Japan, is firmly convinced that the development of such systems is indispensable in many fields of expertise and will be of great importance for officers and managers of government and business circles for regional and community development.

THE "INFOTERRA" SYSTEM

Its Basic Concept and Mechanism

The International Referral System for Sources of Environmental Information, or shortly "INFOTERRA," was originally conceived, designed, and established by UNEP as the linking mechanism through which any nation could gain access to environmental information from every other nation participating in the system.

The system is based on a simple concept. People working in specialized fields have an inherent commitment to remain constantly in touch with the latest information on their subject. Their personal files and the data bases in the institutions they are associated with are kept constantly up-to-date. Further, they tend to subspecialize within their subject areas, and they have practical experiences in dealing with the concrete application of their knowledge.

It is around such expert sources that "INFOTERRA" has been built. Government-designated focal points in 127 countries, now representing 98 per cent of the world's population, select expert institutions within their communities to act as sources of information. Of these, the majority are research institutions, followed by laboratories, institutes of higher learning, libraries, documentation centres, and consultants. They provide publications, reports, expert advice, and assistance and many also provide bibliographic services.

The sources selected by the national focal point (NFP) are compiled in a national register of environmental expertise. All of these sources of information are then made available to inquirers from within the country. The NFP also makes its sources of information available to the worldwide network as a whole. Again, national focal points are responsible for selecting sources for international use.

Once the NFP has established that the source meets the requirements of quality and availability demanded by the "INFOTERRA" international network, it forwards all the necessary details to the Programme Activity Centre (PAC) within UNEP in Nairobi, Kenya. The PAC enters all the details into a computerized file known as the International Directory of Sources of Environmental Information from which the magnetic tape and hard copy versions of the "INFOTERRA" directory are produced. The directory contains a constantly growing number of entries (currently around 6,000) from sixty-nine national focal points and from the PAC itself which registers sources available through international organizations and agencies such as many in the UN system. Regular updating and revalidation of entries in the directory means that the entire file is completely revised every two years.

The "INFOTERRA" Source

All of these sources of environmental information are available to any inquirer on request to an "INFOTERRA" national focal point -- and as they have a vested interest in maintaining their skills in their specialized subject areas, a most economical method is thus found to answer inquirers' information needs.

A qualified "INFOTERRA" source is assumed to possess the following qualities: The skills necessary to answer inquiries on its specific environmental area of expertise; the agreement to provide the available information upon request; and the ability cto answer the incoming requests for information speedily.

Sources of environmental information are registered by their NFPs and listed in the "INFOTERRA" directory. Once registered, a source takes on the responsibility of responding to all requests for information channelled through the system.

As the credibility of "INFOTERRA" depends on the quality of the information provided, "INFOTERRA" has introduced quality control in its selection and re-registration of sources. The nature and quality of the responses received from the sources are monitored by "INFOTERRA" on the basis of continuous user satisfaction studies.

A source must always respond immediately to an "INFOTERRA" request; responses may take one of the following forms: (a) The source provides the information requested by the user; (b) The source advises the user of any delay necessary for the collection and transmittal of the information or requests clarification of the inquiry; (c) The source advises the user of the specific conditions, e.g., language, format, and charges, under which the information can be provided; and (d) Under unusual circumstances, the source may inform the user that the information requested is not available.

"INFOTERRA"

As a supplier of information, sources will often find themselves in need of additional information, particularly outside their areas of specialty, which is not available through their usual information sources. It is here that "INFOTERRA" can be of assistance to such sources, not in their role as a source but as a user. Since an increasing number of specialized organizations have offered their information services to "INFOTERRA" as sources, they now have the opportunity to benefit from using "INFOTERRA" as a user.

How "INFOTERRA" Works

The original "INFOTERRA" system works basically in a very simple but effective way. It is depicted in figure 17, and has the following procedures:

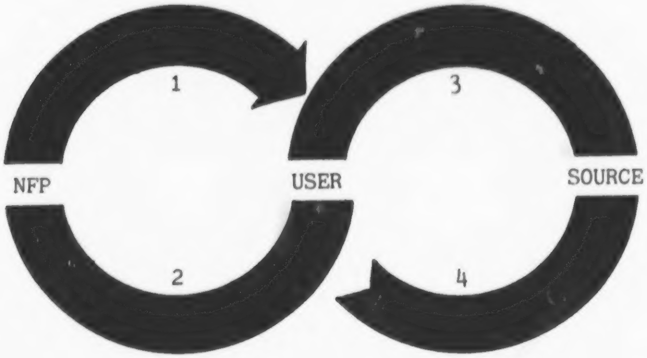
(1) The user formulates an environmental inquiry and requests a NFP to carry out a search of the directory for appropriate sources of information.

(2) The NFP provides the user with a list of sources each annotated with details, subject area and geographical coverage, and conditions for provision of information.

(3) The user directly contacts selected sources requesting the appropriate information.

(4) Sources then provide the user with the information requested according to their own particular conditions.

Figure 17. The "INFOTERRA" Referral Scheme



"INFOTERRA"

"INFOTERRA" now provides access to thousands of expert sources on approximately 1,000 subjects through offices all over the world. At the same time, as the system has been operated and developed since 1977, "INFOTERRA" also provides access to substantive information on selected fields.

In response to an inquiry requesting information on any of the listed subjects, the user currently receives substantive information in the form of bibliographic printouts, published reports, existing legislation, processed data, etc., other than a list of expert sources able to provide additional substantive information pertinent to the user's needs.

Depending on the scope of the question, the information can be local, national, regional, or international. System back-ups include on-line search of bibliographic files, and special sectoral sources on fifteen selected fields.

CURRENT STATUS OF IMPLEMENTATION OF THE "INFOTERRA" SYSTEM

Evolution and Development of the System

The "INFOTERRA" referral system has been fully operational since January 1977, when the first edition of the International Directory of Sources of Environmental Information was published. As "INFOTERRA" activities are financed at the global level as a UNEP-funded project and at the national level by each participating country, evolution of the "INFOTERRA" system has been observed mainly in accordance with the primary mandates based on constant evaluation and issued periodically from UNEP's governing council.

Although inaugurated as a referral system, "INFOTERRA" has now developed into a direct supplier of information. In most cases, NFPs have been able to supply such documents from their own resources and, if not, they have asked the Programme Activity Centre or other NFPs for assistance.

Another service with a growing impact on the user-community has been the establishment of Special Sectoral Sources (SSS) of information. Again, users receive substantive information but processed by an internationally recognized institution qualified to integrate many different aspects of the problem area into a packaged response. Hence, a more comprehensive analysis can be conducted, and supplied.

On-line search of bibliographic files provides an additional service to complement national resources and the references quoted can be accessed either directly or through the PAC.

"INFOTERRA"

At present, "INFOTERRA" is a partnership of 127 countries, of which more than 5,500 sources of environmental information have been submitted. Figure 18 shows the global geographical distribution of countries and NFPs and participants in "INFOTERRA."

Access to "INFOTERRA" services in any country depends on the designation of a NFP and on the commitment and provision of adequate resources by the national government to participate in the system. Since August 1974, when UNEP first invited governments to join the system, the number of NFPS has steadily grown, as shown in figure 19. It should be noted that the countries participating in the network cover more than 95 per cent of the world's population. Since the services provided increase and its network expands as indicated by the growth in number of NFPs, the usage rate of the system has also grown steadily. Figure 20 shows the annual growth in total number of inquiries per annum from 1977 to 1986.

Current Information Network and Flow of "INFOTERRA"

"INFOTERRA" has been operational for ten years. Over 50,000 inquiries have been processed in that time -- the majority being in the past few years. Its information network is steadily expanding.

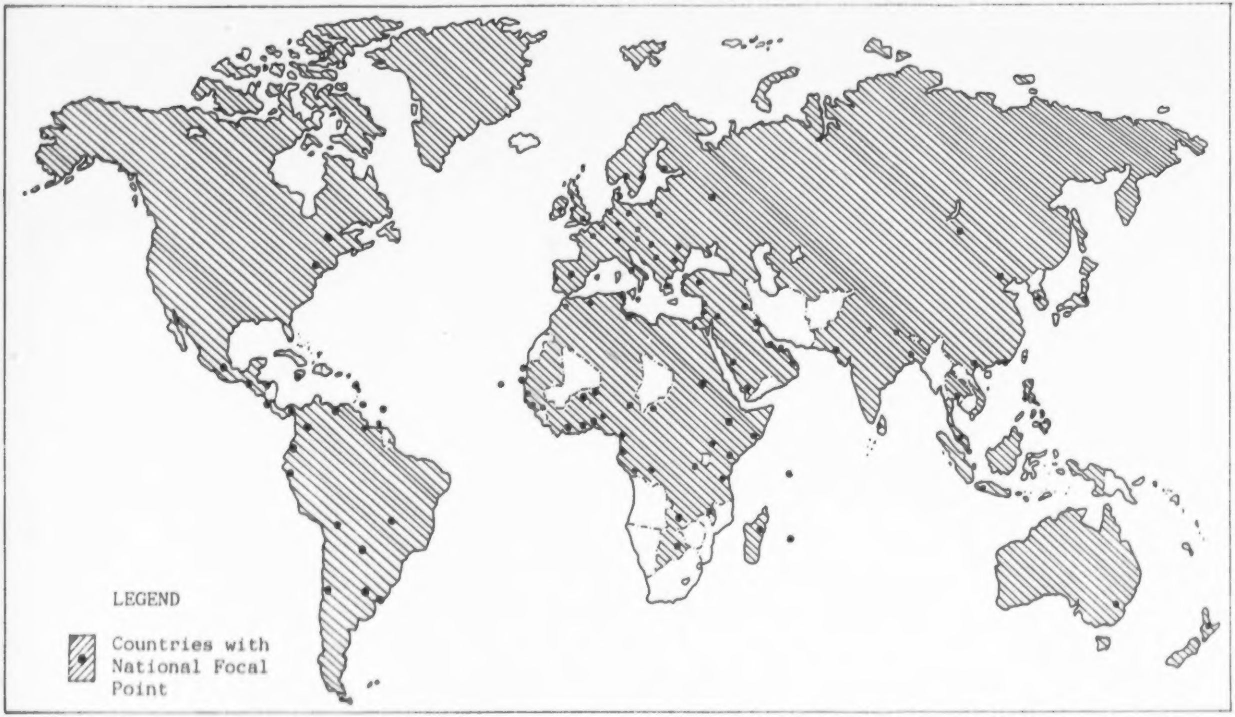
Successive studies on the network have shown that the majority of users (over 69 per cent) have been well-satisfied with the information they have received. Indeed, the number of "repeat users" is constantly growing.

The decentralized nature of "INFOTERRA" stresses the interdependence of the international community while at the same time it is dependent upon the establishment of the national infrastructure needed to create the flow of environmental information within, and between, nations.

"INFOTERRA's" decentralized structure makes it ideal for linking many kinds of facilities into a cohesive network. Instead of a centrally collected data base with its consequential rigid structure, "INFOTERRA" actively seeks international, intergovernmental, and nongovernmental partners with a flexible network structure.

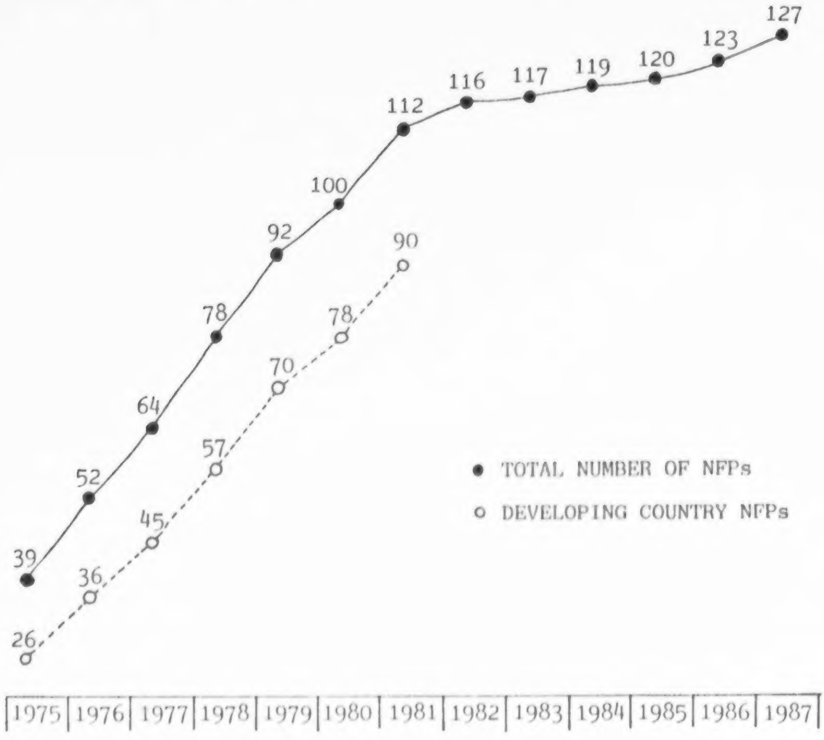
The "INFOTERRA" network structure and its information flow is depicted in figure 21. The information flow designed by the system caters to the needs of inquirers and services to be provided throughout the world.

Figure 18. Global Geographical Distribution of Countries and NFPs


LEGEND
▨ ● Countries with National Focal Point

"INFOTERRA"

Figure 19. Annual Growth in Number of National Focal Points



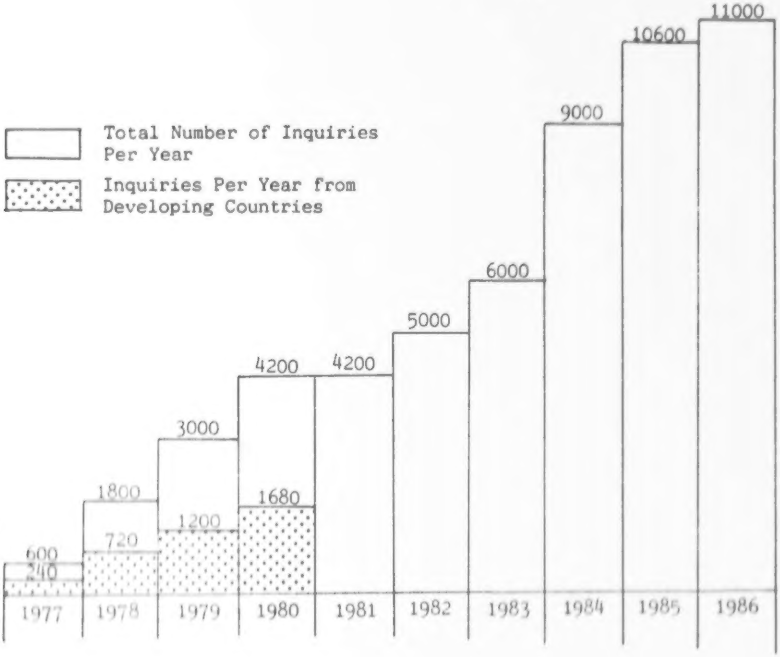
The National Focal Point in Japan and Its Operations

The activities of an "INFOTERRA" NFP may be briefly summarized under the following four main areas:

(1) National Referral Services

In order to provide referral services, the NFP will perform the following activities: (a) Conduct a national inventory of environmental information sources; (b) compile a national directory of environmental information sources; (c) provide referral services to national users; and (d) monitor the effectiveness of the services provided.

Figure 20. Annual Growth in Total Number of Inquiries Per Year

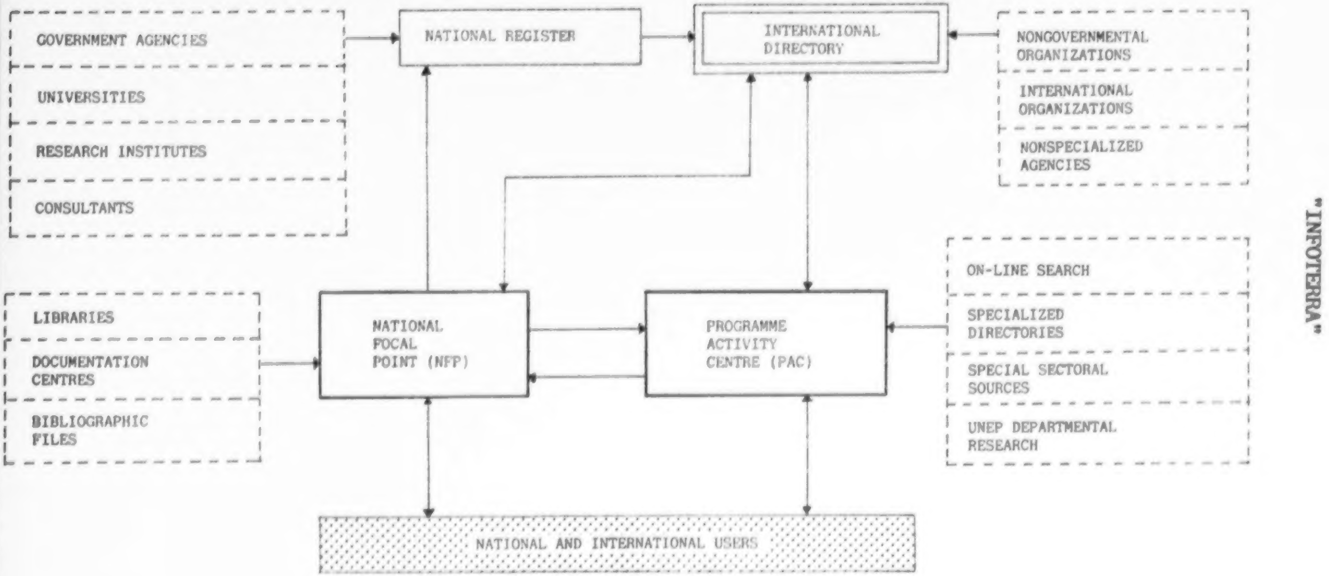


(2) National Environmental Information Services

The aims of the national information services are to: (a) Integrate the focal point into existing national information systems; (b) ensure access to substantive environmental information in the country; (c) build up a national source and user-community; and (d) create a national environmental information system with "INFOTERRA" at the core.

(3) International Information Interchange

In order to participate in the "INFOTERRA" international network, a NFP will need to: (a) Select appropriate national sources for inclusion in the international directory; (b) maintain a copy of the international directory and provide access to it; (c) provide substantive information and referral services to international users; (d) filter users' inquiries, when necessary, to others in the "INFOTERRA" network including the PAC, the Regional Service Centre (RSC), Figure 21. "INFOTERRA" Structure and Its Information Flowchart


GOVERNMENT AGENCIES
UNIVERSITIES
RESEARCH INSTITUTES
CONSULTANTS
NATIONAL REGISTER
INTERNATIONAL DIRECTORY
NONGOVERNMENTAL ORGANIZATIONS
INTERNATIONAL ORGANIZATIONS
NONSPECIALIZED AGENCIES
LIBRARIES
DOCUMENTATION CENTRES
BIBLIOGRAPHIC FILES
NATIONAL FOCAL POINT (NFP)
PROGRAMME ACTIVITY CENTRE (PAC)
ON-LINE SEARCH
SPECIALIZED DIRECTORIES
SPECIAL SECTORAL SOURCES
UNEP DEPARTMENTAL RESEARCH
NATIONAL AND INTERNATIONAL USERS
"INFOTERRA"

or the SSS; (e) revalidate national sources entered in the international directory at specified intervals; (f) maintain the necessary communications in the "INFOTERRA" network; (g) assist in the continued development and improvement of "INFOTERRA"; and (h) maintain statistics on users' inquiries and monitor users' information needs.

(4) Promotion of "INFOTERRA" Services

While carrying out its activities, a NFP will promote "INFOTERRA" services by: (a) Sensitizing users to the value of information; (b) publicizing the services provided by "INFOTERRA"; and (c) promoting the use of "INFOTERRA."

Since being designated as the NFP in Japan in 1975, the Environmental Information Division of the National Institute for Environmental Studies (NIES, JEA) has incorporated many of the abovementioned standard activities necessary to perform the function of a NFP into the regular operations of work. They include source registration and revalidation, provision of referral services to national and international users, development and operation of computerized international and national directories, publication of national directories of information sources, thesaurus of environmental terms, and other promotional materials, and so on.

Two of the latest activities are to be highlighted here. One is the publication of a supplement to the seventh edition of the Japanese "INFOTERRA" Directory of Environmental Information Sources, as 108 additional sources were newly registered within 1986 to take the total number of national sources to 361. The 175-page directory was published in March 1987, and includes information on "INFOTERRA" and annexes both subject and source indices plus a name list of all new sources with their registration numbers.

Another activity is the expansion of the computer search services of the "INFOTERRA" directory. Under an agreement with the Japan Information Centre of Science and Technology (JICST), a government agency, NIES as the NFP in Japan provides the same computer "INFOTERRA" files as it uses so that the files can be included in their on-line commercial system (JOIS). JICST began operation in July 1987.

Being fully operational, the NFP in Japan has been experiencing a relatively lower rate of domestic use expected since commencement of its operation. The reason for this is considered partly because of the language, i.e., English, used for indexing in the referral system, although inquiry is accepted in Japanese. Therefore, preparation of the thesaurus of environmental terms both in English and Japanese is indispensable as well as wider circulation of promotional materials on "INFOTERRA" in Japanese.

Another point that the Japanese NFP currently feels is weak, is in the area of delivery of substantive information to national and international users. Improvement of this particular point may need to narrow down and limit the subject fields for services offered.

CONCLUSION

To indicate the importance of information on the sources, an international referral system for sources of environmental information called "INFOTERRA," which was conceived originally by UNEP, has been introduced on a trial basis.

After being operational in the field of environmental management, this system has been proven to be very effective not only in source referral but also in the promotion of the interchange of information and has thus established a global communication network. In this connection, the nature of "INFOTERRA's" decentralized structure has been found of particular importance in maintaining the flexibility of the overall network.

National focal points with the highest degree of freedom in their own operation of "INFOTERRA" play a key role in the formulation of a world information network. Since most "INFOTERRA" sources are also ardent users, communication between sources and users is automatically developed and enhanced.

Substantive information is that information which is eventually needed by a user. Therefore, any referral system including "INFOTERRA" should, in principle, be supplemented in its development to some extent with bibliographic services, and others, for substantive information delivery.

REFERENCES

Haruyama, A., "Information on Sources in the Field of Environment," *Environmental Information Science* (Kankyo Joho Kagaku), 11 (2: 1982): 10-7 (Japanese text).

United Nations Environment Programme, "Earthwatch: An In-depth Review of INFOTERRA" (UNEP report no. 1) (Supplement no. 1) (Nairobi: UNEP, 1981).

_________, *"INFOTERRA" Operations Manual* (Nairobi: UNEP, 1986).

6

PROMOTING SPATIALLY-ORIENTED REFERENCING SYSTEMS DEVELOPMENT AT THE INTERNATIONAL LEVEL

Sidney W. Witiuk

INTRODUCTION

This paper provides an overview of the scope and extent of activities of the Spatially-Oriented Referencing Systems Association (SORSA) in promoting the development and use of spatially-oriented referencing systems around the world.

Discussion includes the goals of SORSA, the reasons for its existence, and elaboration of its programme of activities. A brief itemization of future plans and mechanisms for cooperation conclude this short paper.

WHAT IS SORSA?

The Spatially-Oriented Referencing Systems Association was founded in 1974 and has the following aims:

- To promote the application of spatially-oriented referencing systems.
- To facilitate communication, disseminate experience, and organize efficient cooperation among organizations and professionals in the field.
- To promote the development of spatial referencing, retrieval, and analysis.
- To encourage the transfer of relevant standards and technology between countries.

SORSA is a nonprofit international association of individuals from twenty-nine countries working with or developing spatially-oriented referencing systems. SORSA has no permanent staff and routine association activities are achieved on a voluntary basis.

WHAT ARE SPATIALLY-ORIENTED REFERENCING SYSTEMS?

Strictly speaking, spatially-oriented referencing systems need not involve Electronic Data Processing (EDP) techniques. However, given the data volumes involved and the growing power and cost-effectiveness of EDP solutions, most of the current systems are EDP-based. What sets spatially-oriented systems apart from standard EDP systems for data handling is the nature of the data being processed and the manner in which those data sets are manipulated. Specifically, spatially-oriented systems perform data capture/encoding, verification, aggregation/disaggregation, retrieval, tabulation, and specialized packaging of data that is referenced to some geometric or topological (or both) framework. These references are typically coordinates (X, Y, and sometimes Z) or geographic labels (names, addresses, etc.) or codes. The spatial references act both as locational attributes and as "keys" for retrieving, combining, or manipulating spatial features or objects. The combination of the bi- or multivariate nature of spatial references and the duality of their function (attribute and "key") make spatially-oriented referencing systems computationally and analytically complex. In addition, large volumes of data and specialized equipment needed to encode and portray graphical entities, are usually involved. Large gains can be achieved from optimization of methods and the computing environment. As a result, there is a strong impetus to learn from the experience of others and to cooperate in developing and using spatially-oriented referencing systems.

Some common applications of spatially-oriented referencing systems technology include:

. Computer Mapping and Cartography

. Urban and Rural Planning

. Emergency Service Dispatch

. Districting

. Allocation/Distribution Modeling

. Routing/Navigation

. Address or Postal Code Geocoding

- Environmental Inventory and Impact Studies
- Utility Network Modeling

WHAT IS THE SORSA PROGRAMME OF ACTIVITIES?

In keeping with its goals, SORSA strives to assist nonprofit organizations, and other appropriate agencies to promote and apply spatially-oriented technologies and techniques. To reduce duplication of effort, Sorsa cooperates with other professional associations and nonprofit institutions.

Two types of assistance are provided through the SORSA programme: (a) direct involvement in specific projects or training activities, and (b) information support tools available to all SORSA members and collaborating organizations.

Direct Involvement

(1) Contracted Consultation.

Whenever appropriate and practical, SORSA undertakes specific tasks aimed at assisting developing countries attain capacities and expertise needed to profit from spatially-oriented referencing systems technology. It is generally preferred that all such work be undertaken under the auspices of an established international organization such as the United Nations and its agencies. Two agencies with which SORSA has cooperated in the past are the United Nations Economic and Social Commission for Asia and the Pacific (ESCAP) and the United Nations Educational, Scientific and Cultural Organization (UNESCO).

Insofar as suitable professionals are available to assist developing countries, SORSA is prepared to put forward the names of potential personal service contractors. SORSA does not charge a fee for such services and does not accept any actual or implied liability on behalf of the referred professionals. If the associated costs are defrayed, SORSA is prepared to assess completed work and comment on its professional veracity.

(2) Direct Sponsorship of Projects.

Within its extremely limited resources, SORSA sponsors worthwhile activities that are directly useful to its members in developing countries and elsewhere. SORSA will also seek the aid of larger organizations to finance the development of "instruments to indirectly assist" developing countries.

(3) Local Expert Assistance.

Suitable expertise from the SORSA membership or which can be identified by SORSA can be utilized to develop, assess, and augment reports aimed at easing the adoption of spatially-oriented referencing systems technology. For example, SORSA members have, in the past, volunteered their time to assess the quality of translations of development guidelines written in English into French and Spanish.

(4) Knowledge Sharing.

Attendance at SORSA Symposia is typically restricted to SORSA members and invited guests. SORSA has a long tradition of extending invitations to colleagues from developing countries to share in the discussion of current issues.

Information Support Tools

A number of mechanisms are currently in place or being planned to indirectly assist development projects by ensuring that useful information or tools can be acquired in a timely fashion.

Mechanisms in Place:

(1) Bibliography.

SORSA is cooperating with the Land-Related Information Systems (LRIS) Project in the Province of Alberta, Canada to produce a comprehensive bibliography of written work related to spatial information.

(2) Information and Demonstration Centres.

Since the late 1970s, an information and demonstration centre containing literature on spatially-oriented referencing systems and a growing number of software products have been housed at Statistics Canada in Ottawa. Recently, a second site has been established at the Department of Geography, University of Maryland, College Park, Maryland, U.S.A. Additional sites in Europe, and India are under negotiation with further expansion planned for Australia and Africa.

(3) Video Tape Courses.

SORSA believes that the medium of video tape can provide an inexpensive and yet effective vehicle for providing introductory training in the field of spatially-oriented referencing systems and intends to encourage their production. SORSA has a growing collection of such tapes located at the SORSA Secretariat for loan to members and collaborators.

(4) Demonstration Systems.

SORSA intends to promote the development and exchange of "prototype" systems to demonstrate the feasibility and potential effectiveness of handling spatial data in an automated fashion.

(5) Calendar of Events Data Base.

SORSA currently operates a data base of meetings of interest to SORSA members. The data base is shared with a number of other international associations. Summary schedules of events are published regularly in SORSA News and are provided to the heads of participating associations, together with detailed information on anticipated, planned, and confirmed future meetings.

(6) Dissemination of Information.

SORSA produces quarterly newsletters and distributes periodic working papers to its members and to kindred associations. In addition, regular and special meetings and workshops are organized to provide a forum for information exchange.

(7) Forming Special Interest Groups.

There are currently nine special working groups within SORSA focusing on the following topics:

(a) Technology Transfer to Developing Countries;

(b) Bibliographies and Glossaries;

(c) Micro-based Systems;

(d) Spatial Data Base Management Systems;

(e) Software Portability;

(f) Academic Activities;

(g) Turnkey Systems;

(h) Standards; and

(i) Benchmarking Spatial Systems.

Planned SORSA Activities:

(1) Inventory of Curricula.

An initial study of acádemic curricula in the United States has been recently completed. SORSA now intends to extend the scope and the coverage of the study to the remainder of the world.

(2) Glossary.

SORSA intends to cooperate with LRIS and with other international organizations in an attempt to standardize the definition and use of terminology associated with spatially-oriented referencing systems. This is a difficult task to achieve in a single language and yet should be undertaken in a multilingual manner. Substantial financial resources will be required to ensure that this project can be undertaken in a timely and effective manner.

(3) Software Inventory.

SORSA would like to participate with other international organizations such as the International Geographical Union (IGU) and the International Cartographic Association (ICA) in an eventual revision of the software inventory produced by the IGU in the first part of this decade.

(4) Guidelines.

SORSA has already participated in the development of guidelines for developing a spatially-oriented referencing system and would like to expand its activities

184

in this area.

(5) Inventory of Professionals.

SORSA would like to participate with other international organizations such as the IGU and the ICA in expanding the coverage and availability of the existing IGU inventory.

(6) Comparative Studies.

SORSA wishes to develop or participate in a series of studies to test the appropriateness of various methodologies, techniques, or guidelines in varying contexts and conditions throughout the developing world.

(7) Development of Benchmarks.

To assist its members and developing nations alike, SORSA intends to promote the establishment of benchmarks that can be used to assess alternative systems for handling spatial data. A special working group was established in 1987 to pursue this goal further.

7

INFORMATION SYSTEMS PROJECT FOR URBAN AND REGIONAL PLANNING IN CHINA

Yu Hong

INTRODUCTION

With the rapid advances in technologies of microelectronics, computers, and communications, China's society is undergoing a transition from an "industry-based society" to an "information-based society." Information is not only an important resource, but also has become the lever to the progress of economy and society. To meet the challenges of the new technical revolution, in the efforts to build China into a modernized socialist country as soon as possible, priority is given to the construction of information systems.

To meet the needs for modernization, the Chinese urban and regional planning and construction institutions have developed a series of computerized information systems.

GENERAL DESCRIPTION

In 1982, the China Academy of Urban Planning and Design carried out, using microcomputers, a statistical analysis and traffic forecast on the basis of 2.4 million items of data to survey the travel patterns of the inhabitants in Tianjin City.

In 1983 and 1984, the Academy carried out data processing to survey the movement of goods in Tianjin City and to survey the travel patterns of inhabitants of Shiyan City in Hubei Province. Since 1983, microcomputers or minicomputers have been applied in more than ten cities to the processing of data on inhabitants' travel patterns.

In 1984, the Nanjing Institute of Technology carried out optimal designing for the site choice of the central zone of Nanjing City on a microcomputer.

In 1985, the Economics Management School of Qinghua University carried out computerized simulation and analysis of population growth in Dalian Prefecture in Liaoning Province. The College of Architecture and Building of Tongji University in Shanghai set up on a microcomputer, models for land evaluation and school-age population calculation. The same college applied system dynamics to the simulation of public traffic systems in Shanghai City and, using this computerized tool, made estimations and evaluations of the possible results from the implementation of different policies in the years to come.

Nanjing University developed an "Urban Information System" for Yichang City of Hubei Province, applying computer network techniques to its urban planning.

The State Bureau of Surveying and Cartography of China applied computers to the interpretation of photographs taken by remote sensing and provided the data obtained to urban planning organizations in several cities.

In 1986, the Huhehot Urban Planning Administration of Nei Monggol (Inner Mongolia) Autonomous Region developed the "Urban Planning and Management System of Huhehot City."

In the same year, the Beijing Urban Planning Administration developed the "Urban Construction and Management Data Base System" and the China Building Technology Development Centre finished the first stage of the development and implementation of the "Urban and Rural Construction Information Retrieval System."

Four of the above-mentioned information systems will be described in detail in this paper.

THE URBAN CONSTRUCTION AND MANAGEMENT DATA BASE SYSTEM

This is an English-Chinese bilingual retrieval and computing system with multiple data bases developed and implemented by the Beijing Urban Planning Administration. It is implemented on a HP 3000 minicomputer and has eight data bases (including 127 data sets and 1,400 data items). Entity relationship model, hierarchical design method, structured programming, and modularization were adopted in the development of this system. The system operates on the QUERY language and a self-developed application programme, which has a retrieval function, a computing function, and a report generation function.

INFORMATION SYSTEMS PROJECT FOR URBAN AND REGIONAL PLANNING

Data on urban planning, and on the development and construction of the capitals and other large cities of many countries in the world, as well as those of Beijing, are included in the eight data bases. These data bases contain the following kinds of information: (a) data base on the basic features of the country in which a city in question is located; (b) data base on urban history and physical geography; (c) data base on urban infrastructure, traffic, and transportation; (d) data base on industry, agriculture, energy sources, and finance; (e) data base on cultural, educational, scientific, and technological institutions and facilities; (f) data base on environmental sanitation; (g) data base on tourist and service trades; and (h) on-line data base dictionary.

The urban data sets concerning a certain city include: (a) data set on urban area; (b) data set on urban geography; (c) data set on urban climate; (d) data set on inhabitants' living standards; (e) data set on urban population and households; (f) data set on housing; (g) data set on industry; (h) data set on agriculture; (i) data set on urban roads; (j) data set on traffic and transportation; (k) data set on energy sources; (l) data set on cultural and sports facilities; (m) data set on education; (n) data set on urban telecommunications; (o) data set on environmental protection; (p) data set on medical and health work; (q) data set on urban water supply; (r) data set on urban drainage; (s) data set on tourist trade; (t) data set on service trades; (u) data set on parks and green land; (v) data set on scientific research institutions and scientific-technical personnel; (w) data set on public security and public order; and (x) data set on finance.

The data sets concerning a certain country or district include: (a) data set on cities with population over one million persons; (b) data set on urban history; (c) data set on municipal organizations; (d) data set on major events of cities; (e) data set on administrative zoning; (f) data set on satellite towns; (g) data set on rivers and lakes; (h) data set on seismology and earthquakes; (i) data set on international organizations; (j) data set on airports; (k) data set on ports and harbours; (l) data set on waterworks; (m) data set on sewage treatment plants; (n) data set on heating plants; (o) data set on power stations; (p) data set on libraries; (q) data set on tall buildings; (r) data set on information institutions; (s) data set on famous universities, colleges, and institutes; (t) data set on hospitals; (u) data set on parks and public gardens; and (v) data set on scenic spots and historical sites.

The hardware of this system includes: a HP 3000 minicomputer, 2648A Hanzi (Chinese characters) terminals, 2631G Hanzi hard copy terminals, and a 2608A printer.

The software of this system includes: an IMAGE Data Base Management System (DBMS), a Chinese character information system (HPCIOS), a KSAM filing system, and editing, compiling, operating, and operation systems in several languages.

This Urban Construction and Management System is intended for the senior officials and leading cadres at different levels and administrative personnel who are mainly interested in the macro data of cities, for example, those on urban population, urban area, gross value of industrial and agricultural output, and so on.

THE URBAN TRAFFIC INFORMATION SYSTEM

This microcomputer-based system, developed and implemented by China Academy of Planning and Design, comprises the following hardware (including peripherals): one 64KB microprocessor; four 316KB, 5 1/4-inch disk drives for data storage; one high-speed printer for output; two terminals; and a small digitizer and plotter to load and plot maps. The operating system is IBM PC-DOS, the Data Base Management System is dBASE III. It has a Chinese character library supported by a CCDOS operating system. Input of Chinese characters is carried out by means of Chinese phonetic alphabets. In the Chinese character library there are 7,000 commonly used Chinese characters. The other Chinese characters may be generated in accordance with actual needs. There are five variations of the type font and size of Chinese characters, which meet different needs.

The structure of the Urban Traffic Data Base in this information system is as follows:

(1) In the data base is stored relevant information on urban traffic in ninety-six large cities of China over the years, including the following types of data:

    (a) data on public traffic: quantity of actually running vehicles at year-end (trolleybuses, buses, taxis, etc.); length of routes in operation at year-end; annual number of passengers (in ten thousand person-times), etc.

    (b) data on traffic control and traffic accidents: annual number of persons killed; annual number of persons injured, quantity of motor-driven vehicles (cars, buses, freight cars, trucks, motorcycles, tractors, etc.) in operation; quantity of nonmotor-driven vehicles (bicycles, tricycles, animal-drawn vehicles, hand carts, etc.) in operation, and so on.

(c) data on roads: average road area per capita and total road area; average road length per capita and total road length; parking area in central district; density of road networks, etc.

(d) data on general circumstances of the city in question: total population of urban district; total area of urban district; total output value of industry, etc.

(2) Three files are established in the data base: data file, command file (used for counting, arithmetic operations, retrieval, and so on), and index file.

(3) For producing statistical graphs, the plotting routine can perform the following functions: variance analysis, multivariate regression analysis, successive regression analysis, and others and it can plot broken-line graphs and histograms.

URBAN PLANNING AND MANAGEMENT SYSTEM OF HUHEHOT CITY

This system stores and manages a great quantity of data on urban planning and construction. It can carry out fast inquiry/response operations and synthetical analysis and can give some results of qualitative and quantitative discrimination so as to provide information for the managerial and administrative personnel to make decisions with.

The main functions of this system are:

(1) Qualitative discrimination of the applications for land assignment or building reconstruction in accordance with given conditions (constraints), including examination of applications for fund and assessment of conformity of planning to required conditions and fire safety distance;

(2) Inputting of data on assigned parcels of land;

(3) Data maintenance;

(4) Searching and printing the literal data information of any block of buildings or single building in a zone in question;

(5) Displaying on a screen or a plotter the plan of buildings in any zone or the plan of a block of buildings or of a single building;

(6) Searching and displaying the graphic data of urban main roads, district roads, and road networks, as well as their literal data (name of road, class of road, coordinates of central axis, elevation, etc.);

(7) Searching of land assignment documents archives over the years;

(8) Searching and outputting of relevant, reliable, original data needed for solving land disputes;

(9) Automatic counting of the frequency of use and inquiries from the land assignment documents archives and carrying out classification and statistical work according to specific demand.

Special features of this system are as follows:

(a) structured programming adopted for the sake of making maintenance and expansion easier;

(b) inputting codes instead of relevant data items;

(c) performing various graphic displays;

(d) uses IBM PC/XT as its hardware.

URBAN AND RURAL CONSTRUCTION INFORMATION RETRIEVAL SYSTEM (URCIRS)

Purpose of the Project

URCIRS was developed and implemented by the China Building Technology Development Centre (BTDC). The purpose of the development of this system was mainly to carry out information retrieval and computerized compilation of the Chinese-language bibliographic and abstracts journals. It is an important component part of the Urban and Rural Construction Information Systems as well as one of the projects in the Seventh Five-Year Plan of the establishment of China's National Computerized Scientific and Technical Information Retrieval System and was developed to meet the various and extensive needs of scientific-technical and managerial personnel in the field of urban and rural planning and construction for relevant information.

INFORMATION SYSTEMS PROJECT FOR URBAN AND REGIONAL PLANNING

History of the Information System Project

The predecessor of this data base is the corresponding manual information system in the form of bibliographic journals: "Bibliographic Journal of Foreign Building Science and Technology" and "Bibliographic Journal of Domestic Building Science and Technology." These two bibliographic journals, first published in 1974, have enjoyed fame and popularity among Chinese urban planners, architects, and civil engineers and have contributed to the progress of urban and rural development, planning, and construction in China. In 1983, a national scientific and technical information retrieval system was adopted by the government as one of the national priority projects. Complying with instructions from above, the CBTDC set about the development of URCIRS.

System Description and Development of the Data Base

The development of the URCIRS was divided into two stages. The first stage, involving the development of data base management software and the setting up of an experimental data base, began in December 1985 and was completed at the end of 1986.

At present there are three data bases on this information retrieval system: a bibliographic data base, a Chinese patents management data base, and a scientific-technical personnel data base.

The first and main data base is the Chinese-language bibliographic data base for worldwide literature on urban and rural planning and construction. Its subject coverage includes:

(1) social science related to urban and rural planning and construction;

(2) natural science and technological basis of urban and rural planning and construction;

(3) regional, urban, and rural planning, environmental protection, and architecture;

(4) building design;

(5) building structures;

(6) civil engineering;

(7) sanitary engineering and building services engineering;

(8) construction materials and products;

(9) building construction and building machines;

(10) building economics and management.

The bibliographic data base on this system contains references and abstracts of specialized books, reports, trade literature, standards, conference proceedings, dissertations, and individual periodical articles indexed by the staff of the Documentation Department of CBTDC since 1986. Current catalogued and indexed records will be added directly to the data base at a rate of 2,200 records (1,200 records of foreign documents and 1,000 records of domestic documents) monthly.

The proportion of the literature on urban and rural planning in the whole bibliographic data base is approximately 10 per cent, and the proportion of foreign to Chinese literature on urban and rural planning that is captured in the data base is approximately 2:3 (40 per cent to 60 per cent).

The completeness of data collection is fairly satisfactory and this bibliographic data base is considered authoritative by the reading public. The reasons for this are:

(1) The China Building Science and Technology Library, which is the largest institution responsible for collecting Chinese and foreign literature on urban and rural planning and construction, provides the majority of data needed by URCIRS.

(2) Institutions engaged in collecting information on urban and rural planning and construction are obliged to submit at least one example of all documents issued by them to CBTDC in accordance with the instruction made by the Ministry of Urban and Rural Construction and Environmental Protection (MURCEP).

(3) Institutions subordinated to the MURCEP are obliged to turn over to CBTDC all the foreign specialized literature received in various international activities and carried back from abroad.

In view of the above-mentioned facts the MURCEP, the organizations and institutions subordinated to the Ministry, and the broad mass of the scientific and technical personnel look on the information generated by the system as the principal channel to obtain knowledge of the history, present conditions, and future developments in urban and rural planning and construction both in China and abroad.

URCIRS is operated on a self-made data base and is not dependent on other data bases to fulfill its function, because the relevant bibliographic data base in the Chinese language is being created solely and exclusively by CBTDC and the existing foreign data bases are not necessarily suitable to the specific needs of Chinese scientific and technical personnel in the domain of urban and rural planning and construction.

The CBTDC has established twenty specialized information networks for the exchange of original documents throughout the country, but as the bibliographic data base on URCIRS is the sole bibliographic information available on urban and rural planning and construction in China, so at present there is no network established for the exchange of bibliographic information in this domain, and there are no institutions cooperating or participating in the URCIRS.

URCIRS is run by a full-time staff with a good knowledge of the subject covered by the bibliographic data base. They are forty in number, among them, thirty abstractor-indexers (twenty certified) and ten computer programmers and systems analysts (five certified).

URCIRS is capable of:

(1) processing bibliographic data of twelve types of documents in twelve languages, and published in thirty-three countries and districts;

(2) creating data bases in accordance with relevant national documentation standards;

(3) carrying out automatic editing, composition, and printing of bibliographic and abstracts journals;

(4) outputting records of foreign documents with titles in both languages of the original text (Japanese Hiragana and Katakana, Roman letters, Russian, Greek, etc.) and the Chinese language; and

(5) maintaining an on-line thesaurus and dictionary.

URCIRS is a menu-driven man-machine interactive and user-friendly system and can display and print in both standard formats and customized (tailored) formats. The system's response time is 4.5 seconds in processing a complex logic expression with seven logic operators and threefold brackets in the experimental data base with 3,000 records.

Hardware Requirements and Software Operating and Application Systems

The hardware of this system includes a WANG VS45 minicomputer (core memory capacity is one million bytes, the memory capacity of the changeable hard disk is 75MB x 2 and that of the dual-sided, double-density diskettes is 1.2MB), a 24x24 dot-matrix printer, two 5224I bilingual (Chinese and English) workstations, and a 2866S-2 workstation in English. The operating system is a WANG VS 6.20 version. The application system (Data Base Management System) is developed in COBOL and BASIC languages by the staff of the Documentation Department of CBTDC.

In the development of the application system the structured system designing technique was used. The whole DBMS was divided in accordance with the required functions into four functional modules and ten submodules which can be linked by "LINKER" subprogramme. For each module, programming, debugging, and operation can be carried out independently. The functional modules include:

(1) a data base creation module;

(2) a master control module of retrieval programme (comprising a submodule for generating inverted index file, a submodule for spreading the reversed Polish notation, a submodule for generating general search instruction, and a submodule for carrying out logic operations);

(3) a module for displaying and printing (comprising submodules for displaying and printing in standard and tailored formats);

(4) a module for automatic editing and compilation (of the "Chinese Building Science Abstracts" and the "Foreign Building Science Abstracts");

(5) a module for timing and counting.

Indexing, Thesaurus, Record Fields, and Standardization

The staff of the Documentation Department of CBTDC has for many years collected, analysed, and indexed literature on urban and rural planning and construction for the publication of manual information systems, but before 1986 they used only the classified indexing method because there was no specialized thesaurus to be used for subject indexing. In view of the fact that subject indexing is particularly suited for deep indexing of abstracts for computer retrieval, the information experts of CBTDC set about designing and developing a thesaurus of terms used in the field of urban and rural planning and construction and those areas of other sciences and technologies closely related to urban and rural planning and construction. This thesaurus is called the "Urban and Rural Construction Thesaurus in Chinese." The editing of this thesaurus has been basically completed and it was scheduled for publication by the end of 1987.

The "Urban and Rural Construction Thesaurus in Chinese" has a complete systematic structure, including preface, description, and use of the thesaurus (indexing rules), thesaurus of terms, subject category index, hierarchical index, permuted index, Chinese-English bilingual index, and Chinese-Japanese bilingual index. Terms in the thesaurus are linked by cross-reference relations. The hierarchical, associative, and preferential relationships are expressed by top terms, broader terms, narrower terms, related terms, and USE and USED FOR references (near synonymous terms). The thesaurus contains 9,868 terms, of which 8,969 are descriptors (preferred terms) and 899 are nondescriptors ("lead-in" terms). The depth of subject indexing is five to twelve. The number of weighted descriptors (asterisked descriptors used as entry terms in the subject index of abstracts journals) is two. In the subject category index of this thesaurus there are 128 subcategories and eighty-nine subsubcategories.

A record in the bibliographic data base on URCIRS may contain the following items: (a) accession number; (b) document type; (c) classification codes; (d) library call number; (e) title in Chinese; (f) title in foreign languages (of the original text); (g) authors; (h) corporate source; (i) geographic location; (j) language; (k) source (journal name, year, volume, number, pagination, and the like); (l) number of figures, tables, and/or references; (m) place of publication; (n) publisher; (o) date of publication; (p) conference date; (q) degree-granting institution; (r) descriptors (controlled terms); (s) identifiers (indexed free terms or supplementary terms); (t) abstract; and (u) ISSN or ISBN.

URCIRS provides five directly searchable fields (descriptor, identifier, author, corporate source, and classification code fields) and two limiting functions (language and publication year). These facilities can be used separately or in combination to meet the search needs. The classification codes can be used in cascaded form to raise the recall ratio.

The system and data bases were constructed in strict accordance with China's national documentation standards, most of which had been revised according to ISO standards. They are: GB2901-82, Format for documentation of bibliographic information on magnetic tape; GB3468-83, General editorial rule for retrieval of periodicals; GB3793-83, Descriptive rules for periodical entries; and GB3860-83, Documentation guidelines for determining the subject and subject indexing.

As for compatibility, the English translation of descriptors in the Urban and Rural Construction Thesaurus in Chinese is compatible with the TEST and SHE systems and the Japanese translation of descriptors is compatible with the JICST Thesaurus, but the subject headings and classification system are constructed by the documentation staff of CBTDC and are not compatible with international standards.

Services Provided and Achievements Gained

Though the Urban and Rural Construction Information Retrieval System has not started providing actual service to users because the bibliographic data base's size has not grown large enough, yet one can anticipate its usefulness and popularity in the light of the success achieved in 1985 by the predecessor of the bibliographic data base -- the corresponding bibliographic journals. These two manual searching tools provided 30,000 records of information to users, and the staff of the Documentation Department of CBTDC, on the basis of these bibliographic journals, gave documentary and technical consultation more than 1,000 times. The annual average income from the consultation services has been approximately equal to 200,000 Yuan (RMB), that is, about US$50,000.

The system is designed to provide the following services:

- retrospective retrieval and SDI services, namely, to issue the printed version of the data base and to deliver, within three days, the search result (either the off-line printed records or the paper copy of the original documents) to users, both in China and abroad, by air mail;
- to issue a magnetic medium version (in machine-readable form, e.g., on floppy disks or on magnetic tapes) so as to promote the establishment of a distributed information retrieval network (decentralized acquisition, centralized processing, and decentralized service) with its nodes in different provinces and relevant organizations throughout China;
- to issue (in the future) an English machine-readable tape edition of the Chinese literature in the data base;
- to join in the China National Retrieval System of Scientific and Technical Information in the future in order to

facilitate nationwide on-line search in using URCIRS.

The products of the system can be delivered to users abroad in different required languages at a reasonable and moderate price (including payment to translators) at US$20-30 per 1,000 Chinese characters.

With the wider adoption of facsimile transmission equipment in China, CBTDC may use this to deliver documents to the users.

Factors that Contributed to the Initial Success in the Development of URCIRS

The Leading Group of the National Scientific and Technical Information Retrieval System of the China State Commission of Science and Technology demands that every ministry should have its own specialized bibliographic data base and that the MURCEP should accomplish the task of creating a specialized bibliographic data base with 30,000 records by the end of 1988.

The MURCEP allocated, in 1985, 350,000 Yuan (RMB) (approximately US$100,000) to the first stage of the development and implementation of URCIRS and decided to allocate a further 270,000 Yuan (RMB) (approximately US$76,000) in 1987 to the second stage of development. This project has been carried out solely through internal financing. It is self-evident that the MURCEP has made and will make the necessary minimum financial investments to maintain the system.

The information personnel for bibliographic control and analysis, computer programmers, and systems analysts have made great efforts to master the relevant knowledge and techniques necessary for successful operation of the system.

The systems analysts have used the experience of foreign online information retrieval systems and have transplanted some of their advanced system capabilities to the URCIRS.

Between the documentation staff of the CBTDC and the information producers of other ministries, links have been established in the form of meetings and seminars sponsored by the China Society of Scientific and Technical Information.

Problem Manifestation in Implementing the Information Systems Project

In spite of the above-mentioned achievements, there exist some gaps in system capability and data to be filled up, namely:

(1) the data base size is still small;

(2) the system does not have the capability of searching in a linear sequence;

(3) except for the classification codes field, there are no facilities for term truncation (right-hand, internal, and left-hand);

(4) the system has not yet been loaded with the Urban and Rural Construction Thesaurus and hence does not possess on-line capability to display the thesaurus;

(5) searching and data input are carried out only by means of Chinese characters, as there are no equivalent (corresponding) numeric codes;

(6) there is no capability of checking whether there are repetitions of the document records;

(7) the accession numbers are now assigned manually in the sequence of classification codes.

The filling up of these gaps is the task to be fulfilled in the second stage of the development and implementation of URCIRS. As there are several experienced and skilled systems analysts, computer programmers, abstractors, and indexers in CBTDC, these problems should not be difficult for them to resolve. New capabilities are being added to the system, the programme used for on-line thesaurus displaying is being designed, and the data base size is becoming larger and larger. By the end of 1987, therefore, the gaps in URCIRS were expected to be filled up.

The sole problem of the second stage of implementation is the shortage of financial assistance for acquiring more hardware, because there is no possibility of obtaining funding from other sources.

CONCLUSION

The above-mentioned facts demonstrate that China has made some substantial advances in the development and implementation of information systems for urban planning and construction. But it also should be pointed out that there is still a big gap in terms of not only information technology, scale of operations, and degree of spread, but also in design philosophy and design practice between China and technically advanced countries, and even some developing countries. Therefore, keeping well-informed about new design trends, new information technology, and new methodology is very important for Chinese information experts, urban planners, architects, and engineers.

In order to speed up the modernization of urban planning and construction in China, more attention should be devoted to the following tasks:

(1) taking the application of microcomputers to the field of information services as the main orientation of development, and the use of microcomputers as effective tools to build up office automation systems, publishing systems, simulation teaching systems, scientific-technical achievement management and personnel management systems, and bibliographic information retrieval systems;

(2) developing functionally competent urban planning and construction-oriented software packages to standardize all relevant programmes;

(3) spreading the application of CAD (computer-aided design) systems to reduce the workload of designing and drawing;

(4) establishing a national computerized information network in the field of urban planning and construction, with every province, autonomous region, and large city having its own specific data bases;

(5) developing urban planning and construction-oriented knowledge bases and expert systems to facilitate administrative and scientific-technical personnel decision making.

8

INFORMATION SYSTEMS PROJECT FOR URBAN PLANNING AT THE BANGKOK METROPOLITAN ADMINISTRATION

Arporn Chanchareonsook

INTRODUCTION

The Bangkok Metropolitan Administration (BMA) is still experimenting with computerization in information systems for urban planning. There are a few computer-aided information projects within certain departments of the BMA. These projects, concerned with dedicated systems, are allocated to a single specific use, such as administration, or creation of an inventory system for a specific information theme. However, more integrated information systems, such as the Tax Mapping Project, are still handled manually and in a time consuming way.

Recently, Bangkok gained access to new technology and started the development of data banks for land-related information by the Department of Lands. The Computerized Land Titling Project for one of BMA's twenty-four districts is now under execution and will result in accurate and up-to-date cadastral maps (scale 1:1,000). With technical assistance from foreign countries, the BMA studied four computerized information systems. Two pilot projects on Urban Land Information Systems in two test-site areas in Bangkok have been completed. The pilot projects' final reports were submitted to the BMA early in 1987.

This paper will examine and evaluate the current information systems projects at the BMA, focusing on the Manual Tax Mapping Project. The foreign technical assistance projects, especially the Land Information Systems Projects which are most relevant to information systems for urban planning will also be discussed. Some comments will then be made on future information systems for urban planning at the BMA.

THE PRESENT SITUATION AT THE BMA

In 1986, the Bangkok Metropolitan Administration was responsible for an area of 1,568 km^2 with a population of 5,460,915. This area is divided into twenty-four districts and 150 subdistricts. There are about 1 million land parcels within the entire BMA area, where 10,000 parcel transactions take place each month. There are 34,000 permits issued annually for building units which cover a floor area of 7 million m^2. These rapid changes, occurring in this metropolis, point to the need for a greater understanding of BMA's problems prior to making decisions on future urban development and management policies, as well as on strengthening BMA's administrative efficiency. Information systems are becoming increasingly recognized as essential management tools by the local authorities.

RECENT COMPUTER-AIDED INFORMATION SYSTEMS PROJECTS

The Computerized Land Tax Collection Project

Following the study of the Computer Applications Committee established by the BMA in 1976, the Computerized Land Tax Collection Project has operated at the BMA since 1978. Based on this pilot operation within a specific area in Bangkok between 1978 and 1981, the BMA could increase land tax revenue by baht 5 million. Currently, data concerning landownership supplied by the Department of Lands for the whole area of Bangkok are processed on a computer HP 3000 series 42 with the following features and peripherals: one MB main memory; 404MB disk storage; two magnetic stream devices; fifteen terminals; and one printer 900 lines/min.

This computer is operated by BMA's Department of Policy and Planning. There has been an increase of some baht 7 million in land tax from utilizing this system between 1982 and 1986.

Other Computer-Aided Projects

There is an ongoing project at the Department of Public Works, to set up a road inventory system. This inventory would consist of six data bases respectively for the control links, bridges, pedestrian bridges, pavement, public utilities, and intersections. These data bases will be managed on microcomputers with the following features: Microprocessor NEC N5200/05NKII (768KB); Hard disk unit NEC N527-11 (20MB); and Printer NEC N5233-61 Dot Matrix printer.

IS PROJECT, BMA

The software environment is constituted by the Operating System MS-DOS V2.11 and the Data Base Management System dBASE II V2.4.

Another ongoing project for training purposes is being operated at BMA's Department of Sewerage and Drainage, with the AutoCAD software and the PC-AT hardware with: Enhanced Graphic Adapter; Enhanced Color Monitor; A1 size digitizer (Houston-Instrument); and A3 size plotter (Houston-Instrument).

On this pilot project, a specific area was digitized from a map at a scale of 1:20,000 (RTS) in order to produce a line map showing all the roads, canals, railways, and borderlines between districts. Additional information was provided by field surveys. The following graphical information can be seen on the screen: the width of the road; the width of the sidewalks; the location of the manholes; their cross sections; and the profile of the road, showing the centre line of the road, the left and right footpaths, and the centre line of the sewer pipe.

URBAN PLANNING INFORMATION AT THE BMA

So far some technical details on ongoing computer-aided projects at the BMA have been described. Now I will concentrate on urban planning information as I experience it on a daily practical basis at the City Planning Division. I will first explain how we handle manually important planning information, and in the conclusion, I will present some suggestions on how the manual procedures should be streamlined and shortened. This is where the computer comes in as a useful tool in the organization of the ongoing planning process. In other words, the system will first be discussed and then the instruments.

Urban Planning Data Bases and Data Management

On a routine basis, different kinds of urban planning data are being collected, updated, and analysed, according to the planning priorities. The planning data bases at the City Planning Division of the BMA might be classified into six main categories.

(1) Mapping: common base maps scale 1:1,000 (379 sheets); additional building and road maps scale 1:1,000 and 1:2,000 (covering the entire 1986 urbanized area); road system maps scale 1:10,000 (400 km^2); topographic map scale 1:50,000 (for the entire BMA); and topographic map scale 1:100,000 (for the entire BMA and adjacent areas).

The common base maps used are referred to as Police Maps which were compiled from the photo mosaic (scale 1:5,000) controlled by ground survey using a slotted template technique. The photographs (scale 1:15,000) were taken in June 1958.1/ There are a total of 379 maps covering the inner-city area. The additional building and road maps (scale 1:1,000 and 1:2,000) are derived from the City Planning Division's Tax Mapping Project which will be discussed later in this paper. The topographic and road system maps were compiled by the Royal Thai Survey Department. All these maps show the boundary lines of districts and subdistricts which are essential for administrative and information cross-references.

The base maps are continually updated, and approximately 100 personnel are involved in this process at the execution period of the Tax Mapping Project. During the normal period only limited field surveys and the construction projects of the government agencies' layout plans as well as the building permit records constitute the main sources of information for updating the base maps.

(2) Taxation/cost recovery: assessment/tax; land/buildings; house numbers; street names; building-use/building type; vacant land-use; tenants; parking/garage; and signboard type.

(3) Population: population census; population change; population distribution; age-sex pyramid; employment/unemployment; types of industry employed; income; education; daytime population; and low-income groups.

Some items on population information are derived from the National Statistical Office's Population Census for the specific time interval. Some information has been received regularly from the Central Population Data Base Centre, Department of Local Administration, Ministry of Interior. Other detailed information, such as daytime population and low-income groups, has been derived from the City Planning Division's own research projects.

(4) Land-use planning: land/buildings; existing road network; proposed road network; traffic characteristics; vehicle registration; existing utilities network; proposed utilities network; business registry; industry registry; location of loading and unloading areas; wholesale and retail; building-use; building permits records; building height; size of building; building material; age and condition of building; open spaces; recreation areas; agriculture areas; land-use zoning; location and types of agriculture; building and areas for conservation; and canals/rivers/retention areas.

Land-and building-use information is mainly solely gathered by the City Planning Division.

(5) Social, economic, and cultural: employment/unemployment; education; health/welfare; land tenure; job opportunities; and popular participation.

These data have been collected at a specific time and at the area where a certain project, such as slum improvement or redevelopment project, will be taking place. Information on details is essential for the authorities to have during the decision making process.

(6) Implementation information: administrative; political; institutional; legal; financial; coordination; and other related information such as the annual budget; allocation for urban development and maintenance projects, and actual implementation cost and work description.

At the BMA, the subdistrict is the smallest unit for planning and control of the urban development process. Therefore, the City Planning Division aims to have the planning and control data assembled at this level at regular twelve-month time intervals. This will give us better control over the actual development and is beneficial to the BMA, since taxes can be collected more rapidly, better, and thoroughly. With the existing manual system, the City Planning Division follows the method mentioned above. Different planning information themes generated at the same time are collected on the same subdistrict. Despite the limitations of the manual approach, the information collected graphically and nongraphically on the same subdistrict helps us to more clearly understand the development pattern at the subdistrict level.

THE MANUAL TAX MAPPING PROJECT

History

The BMA is confronted with the collection problems of three major taxes -- the land tax, the building tax, and the signboard tax -- which are its main sources of revenue. Since 1978, the information from the Department of Land's landownership index has been computerized for land tax collection at the BMA, resulting in an increase in revenues. In 1979, the BMA Authority decided to study the improvement of information for collecting the building tax and the signboard tax.

IS PROJECT, BMA

Purpose

As the building and signboard taxes are building-based, the City Planning Division has been assigned to carry out the Tax Mapping Project with a dual purpose:

(1) To prepare the information files in graphic and non-graphic forms of the location of taxable buildings and signboards for better tax collection management; and

(2) To provide access to up-to-date information on land- and building-uses which will be beneficial to the planning of zoning control.

Funding

To study the details of land- and building-uses and the number and types of available signboards in the BMA area -- covering some 920,000 buildings -- and the urbanized area -- encompassing 500-600 km^2 -- is an enormous task. The Tax Mapping Project was a seven-year project, commencing in fiscal year 1980 through to 1986. With a temporary personnel of 150 to 200, under the supervision of about thirty permanent staff from the City Planning Division, the project has been executed annually. Project financing had been made available through allocations from BMA's annual budget of about baht 2 million. The total cost of the project was baht 15 million.

System Description

The project involved four main steps of work, described as follows:

(1) Prepare correct and up-to-date maps (scale 1:1,000) for survey and interview purposes.

(2) Survey of the location, the number of buildings, building types, building-uses, location types, and sizes of the signboards. Interview on the type of activities performed in the buildings, the occupants' status, rent figures, and other tax-related information.

(3) Apply building and signboard tax codes to the building on the map.

(4) Prepare the final tax maps.

The two steps of the Implementation Flowcharts of this project are shown in figures 22 and 23.

The Data Base

The base map (scale 1:1,000) with the buildings, the building numbers, streets, and the survey block control are used as the position data bases of the Tax Mapping Project, while the building and signboard tax codes are the thematic data bases.

Kinds of Data Collected

Tax information on about thirty-nine buildings and signboards is being collected for coding. Other information for planning purposes has been simultaneously collected, such as building types, building height, building-uses, land-uses, and vacant land.

Uses of Information Derived from the Information System

The graphic information or tax maps derived from the Tax Mapping Project are forwarded to BMA's district offices for comparing with their existing data files and for making a field inspection of the new taxable buildings and signboards. The tax map enables the districts to collect more building and signboard taxes. From the initial evaluation of the use of tax maps of four districts, some additional baht 30 million in taxes are gained from these districts.

The other part of the information -- the nongraphic information on building and signboard taxes -- is forwarded to the Revenue Division for data processing in the Policy and Planning Department's HP 3000. Unfortunately, there is some delay at this stage as no up-to-date cadastral map is available for referencing. Using the street network is not very applicable.

The urban planning information derived from this Tax Mapping Project has been collected and analysed for the City Planning Division's planning purposes. Some useful findings such as nonregistered or illegal service-industry premises have been discovered in the project area. This helps the city to further plan for a better environment and control.

BMA's tax maps are considered as currently available useful base maps. The other departments within the BMA and other agencies, as well as the education agencies and the general public have requested these maps for their own use. With the manual

Figure 22. Mapping Preparation: The Manual Tax Mapping Project Work Flowchart

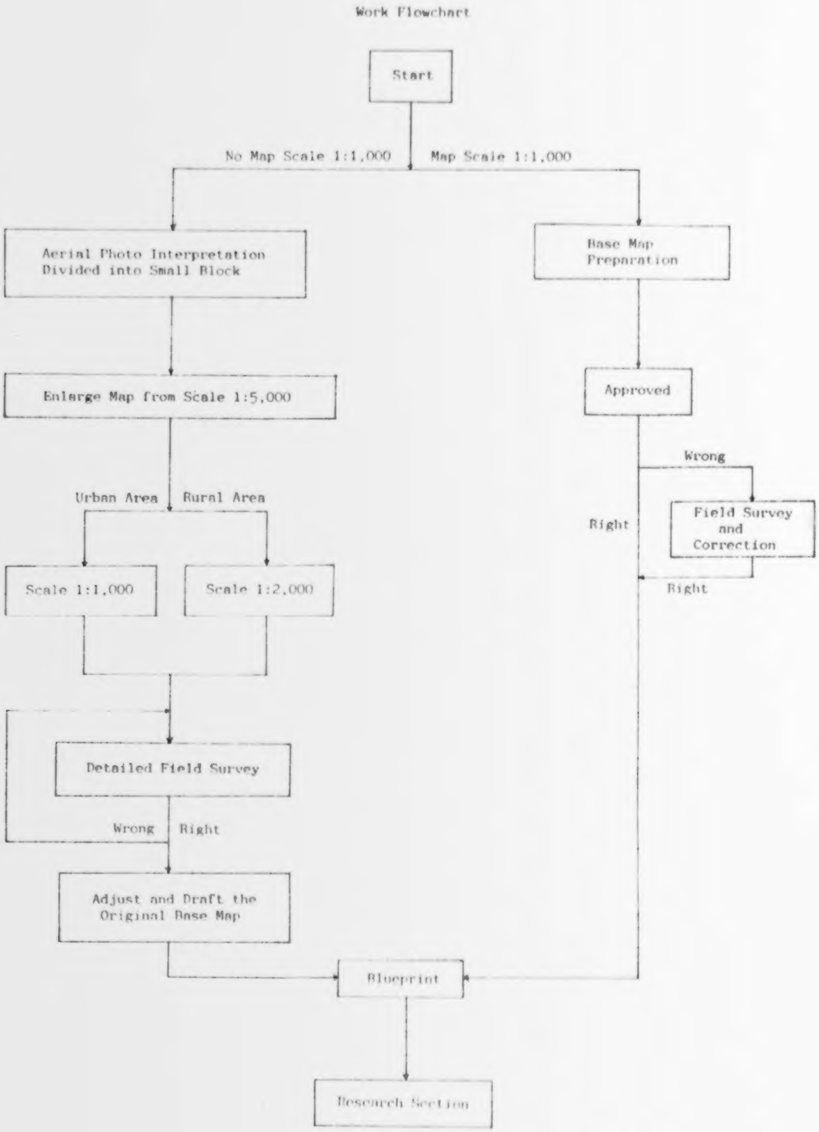
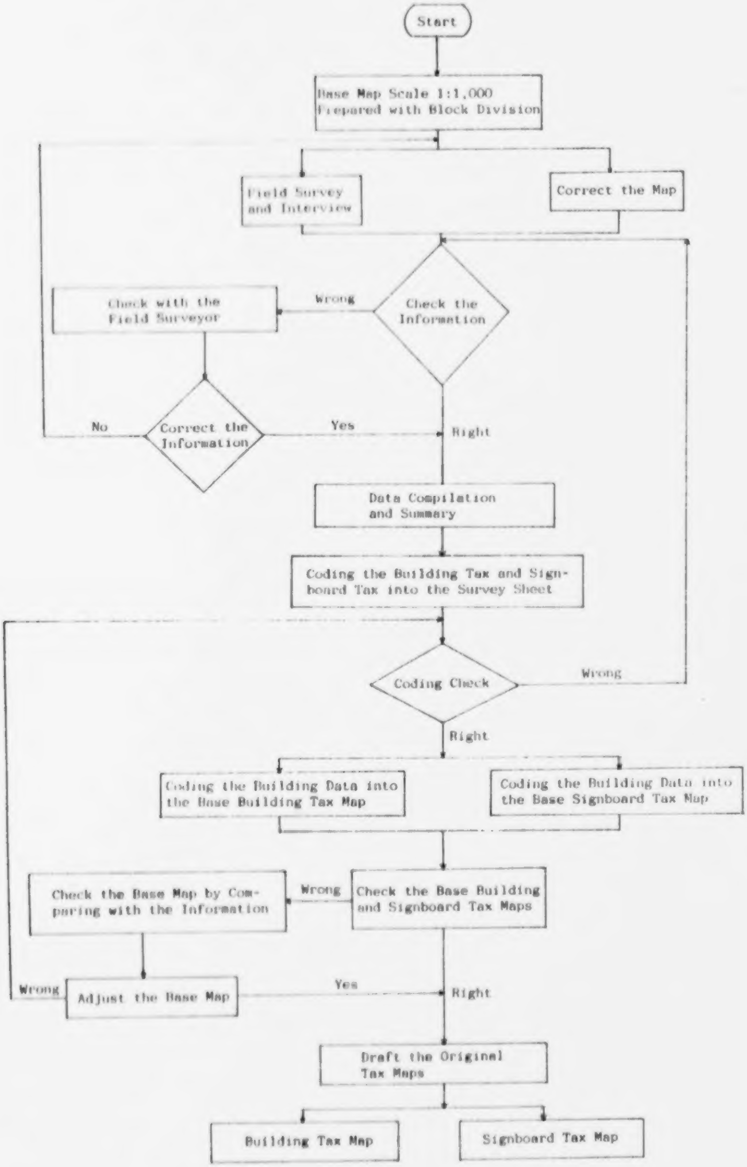

Work Flowchart
Start
No Map Scale 1:1,000
Map Scale 1:1,000
Aerial Photo Interpretation Divided into Small Block
Base Map Preparation
Enlarge Map from Scale 1:5,000
Approved
Wrong
Urban Area
Rural Area
Right
Field Survey and Correction
Right
Scale 1:1,000
Scale 1:2,000
Detailed Field Survey
Wrong
Right
Adjust and Draft the Original Base Map
Blueprint
Research Section

Figure 23. Compilation of Information and Tax Mapping Preparation: The Manual Tax Mapping Project Work Flowchart


Start
Base Map Scale 1:1,000 Prepared with Block Division
Field Survey and Interview
Correct the Map
Check with the Field Surveyor
Wrong
Check the Information
No
Correct the Information
Yes
Right
Data Compilation and Summary
Coding the Building Tax and Signboard Tax into the Survey Sheet
Coding Check
Wrong
Right
Coding the Building Data into the Base Building Tax Map
Coding the Building Data into the Base Signboard Tax Map
Check the Base Map by Comparing with the Information
Wrong
Check the Base Building and Signboard Tax Maps
Wrong
Adjust the Base Map
Yes
Right
Draft the Original Tax Maps
Building Tax Map
Signboard Tax Map

approach, however, the maintenance of information constitutes one of the major problems for this project.

ASSISTANCE OF OVERSEAS ORGANIZATIONS

As much of the important information for decision making processes on urban management and administrative policies is on, or can be related to, land, the BMA decided in 1984, that "Land Information Systems be studied to determine their impact on the development policies and the economics and efficiency of the BMA." The Land Information System (LIS) steering committee, with its members from related departments within the BMA and other concerned agencies, was established to implement this policy. The steering committee was particularly given the responsibility of studying and advising on the benefits of the LIS for use in the following areas: Taxation; registration of properties; laying out of public utilities; planning of flood control and drainage; and urban development planning and management.

The LIS is a recently introduced technology at the BMA. As a result of discussions with various international groups who are specialists in this area, two LIS proposals were received from the Northwest-Stewart Weir Group, with the support of the Canadian International Development Agency (CIDA) and Q. A. C. S. Overseas Projects PTY Ltd. of Australia. At the same time, two other foreign organizations from Japan and Belgium have proposed assistance to the BMA on mapping programmes. A brief description of the projects and recommendations proposed by each team follows:

Pilot Project on a Computerized Land Information System for BMA: The Canada Group

The area selected for the pilot project is located in an inner district of the BMA covering an area of 8.4 km^2. The test site of 500m x 500m within the mentioned district is the area for demonstration of urban land information system applications to the integration of land data.

The Canada team had prepared the positional data bases of the pilot project with the reference datum based on the Universal Transverse Mercator (UTM) projection. The team provided additional necessary control for the new aerial photography which was taken at the scale of 1:4,000, 1:6,000, and 1:12,000 for the purpose of this project. The Cadastral Survey Data Base has also been prepared with the assistance of the Department of Lands. This would constitute very useful land information in relation to the tax mapping project.

The Canada team's Computerized Land Information System for Bangkok includes six thematic data bases. The themes selected for demonstration purposes were: Planning, Water Services, Telephones, Electrical, Sewers, and Cadastral.

The Canada Group recommended a user-needs study prior to the LIS installation. An approach is needed to identify the initial users' requirements, to develop a prototype, to use and evaluate the prototype, and to revise the prototype.

Pilot Project on Large-Scale Mapping and Urban Land Information System: The Australia Group

The Australia Group carried out a pilot project study on LIS in another area of Bangkok in 1985. By using up-to-date accurate orthophoto maps, the study demonstrated the benefits of: Flood control planning; the planning and design of public works; tax collection; and utilities and public administration.

The Australia Group recommended a phased development of LIS in Bangkok. It stressed the importance of the project definition study, and the priority of mapping and the digital map base, which will benefit the city's development and administration in the short-term.

Topographic Mapping of Bangkok Metropolitan Area: The Japan International Cooperation Agency (JICA)

This project is a three-year project commencing in fiscal year 1986. The objective of the project is to prepare a 1:10,000 scale topographic map covering an area of approximately 2,000 km^2 in the BMA area, and a 1:4,000 scale topographic map covering an area of approximately 300 km^2 in the centre of metropolitan Bangkok. A 1:20,000 scale aerial photograph will be taken covering an area of approximately 4,000 km^2.

This project constitutes a grant to the BMA from the Government of Japan. At present, some parts of the work on aerial photography, ground control point surveys, and field identification have been completed. Other stages of the work are underway. This mapping project will be very helpful for general planning and administrative purposes.

Computerized Mapping for the City of Bangkok: The Belgium Group

The Belgium Group submitted an "Analysis Report of a Computerized Mapping Programme for the City of Bangkok" early in May 1987. The Group further proposed to provide the BMA with technical assistance in implementing a pilot project on a utilities mapping programme utilizing the Department of Land's Land Titling Project's aerial photographs on a 60 km^2 area.

Urban Mapping under the Land Titling Project: The Department of Lands

The ongoing World Bank/Asian Development Bank-funded Land Titling Project of the Department of Lands is considered to be very useful to other LIS and Mapping Projects in the BMA area, as the aims of these projects can be complementary. The proposed Bangkok urban mapping under the Land Titling Project, which commenced in 1986, will provide rectified aerial photographs with derived cadastral overlays. The scales to be used will be the standard 1:2,000, and 1:1,000 and 1:500 where suitable.

CONCLUSION

The City Planning Division is currently entering a phase of increased activity in the area of urban planning. The management of urban information through the existing manual system is becoming incompatible to the work. The concept of the computerized information system is now under consideration, with the routine work as a priority. In the short-term, a dedicated computerized system should be in use at the Research Section. At the same time, the pilot project on urban mapping utilizing rectified aerial photograph from the Land Titling Project of the Department of Lands, or from the Land Information System Pilot Project of the Bangkok Metropolitan Administration should be initiated at the Mapping Section, for the training of the concerned personnel. The outcome of this project would be accurate, up-to-date maps which are useful in urban planning projects and for administrative purposes.

In the long-term, a computerized land information system might play a major role in information systems for urban planning in Bangkok.

As the computerized information system is a new technology for the BMA, the training of the concerned personnel as well as technical assistance for selecting the technical alternatives in each step would be very beneficial for the City of Bangkok.

NOTE

1/ The Worldwide Surveys, Inc. took the photographs, in cooperation with the Royal Thai Survey Department, and on behalf of the Bangkok-Thonburi City Planning Project and the Thai Technical and Economic Committee. Funds were provided by the U.S. International Cooperation Administration under contract no. ICA-TH-TTEC N 194/453.

REFERENCES

Australian Study Team, "Land Information Systems Preliminary Study." Prepared for the World Bank/ADB Land Titling Project (Bangkok: Dept. of Lands, Ministry of Interior, 1985).

City Planning Division, Bangkok Metropolitan Administration, "Manual Tax Mapping Project for the BMA, 1980-Date" (Report) (Bangkok, 1987).

Department of Policy and Planning, Bangkok Metropolitan Administration, "Computerized Land Tax Collection Project for the BMA, 1978-Date" (Report) (Bangkok, 1987).

Harper, Robert H., "Information Systems in Support of Managerial Planning/Control" (Paper presented at the 1979 IBM University Workshop on Computers in Urban and Regional Planning, Asian Institute of Technology, Bangkok, October-November 1979).

Japan International Cooperation Agency, "Plan of Operation for the Topographic Mapping of Bangkok Metropolitan Area" (Bangkok, 1987).

Morgan, J. F., "Land Information Systems in Australia" (Paper presented at the 1979 IBM University Workshop on Computers in Urban and Regional Planning, Asian Institute of Technology, Bangkok, October-November 1979).

Northwest-Stewart Weir Group, "Computerized Land Information System for the Kingdom of Thailand, Bangkok Metropolitan Administration, Pilot Project Report" (Final report) (Edmonton, 1987).

Queensland Association of Consulting Surveyors, "Bangkok Metropolitan Administration Area, Pilot Project; Large-Scale Mapping and the Urban Land Information System" (Final re-

IS PROJECT, BMA

Tractebel Consultancy, "Computerized Mapping for the City of Bangkok" (Analysis report) (1987).

9

REMOTE SENSING SYSTEM AND DIGITAL PROCESSING FOR REGIONAL PLANNING AND URBAN MONITORING IN INDONESIA

Suroso Moersidi

INTRODUCTION

At present Indonesia is implementing the Fourth Five-Year Plan, which was started in April 1984 with the following principles:

(1) All resources, particularly natural resources which are required for national development, should be exploited efficiently, taking special care to maintain the environmental and sociocultural equilibrium.

(2) Long-term spatial planning and management should be undertaken to achieve optimum utilization of resources.1/

The National Strategy Development Project was established to ensure the success of the Plan through two approaches, the first, based on a national development approach, and the second, based on a regional development approach. Both approaches must be in the framework of national development through optimization of plans and programmes which stress economic growth, based primarily on the development of the agricultural sector, especially the production of rice.

The optimization of plans and programmes depends on the availability, accessibility, and reliability of data. To understand and to influence structures and development processes effectively, tools and instruments for data handling are needed. An appropriate information system is therefore an important vehicle for information supply which is intended not only to enhance the quality of available data but also to improve data collection and data processing, thereby creating an effective decision support system.

REMOTE SENSING SYSTEM AND DIGITAL PROCESSING

Information systems for development planning in the field of urban and regional planning can be divided into four groups, according to the social structure, the economic structure, financial structure, and physical structure.2/ From the operational point of view, these four groups must have a common reference point. Jan P. Van Est has said that "Spatial referencing is a fact of all sectors and therefore plays a crucial part in coordinating information."

Remotely sensed data, which is data and information concerning natural and socioeconomic resources derived through aerial photographs and/or satellite imaging, serves as the required data for a spatial information system.

This study examines the remote sensing system and data processing techniques, as tools to facilitate regional development planning and urban monitoring in Indonesia. A system was established in 1980 by the Ministry of Public Works, which has a basic responsibility for infrastructural development and actively supports other national development organizations in an integrated manner by long-range and integrated spatial planning.

HISTORY OF THE INFORMATION SYSTEM PROJECT

National Development

As stipulated in the 1945 Constitution, the country's ultimate goal is the social welfare of the people of Indonesia. In pursuing this goal, the government embodied its development in a series of Five-Year Development Plans starting in 1969. The series of Five-Year Development Plans is based upon the General Development Policy (*Garisgaris Besar Haluan Negara* or GBHN); the Plans are formulated by the President with the assistance of BAPPENAS (National Planning Board). Budget control for the implementation of the Five-Year Plans is exercised by the Ministry of Finance and by the Parliament.

Projects implemented during a Five-Year Plan are classified under one of the following headings: "national project," "regional project," or "special project." More explicitly, these classifications may be defined as follows:

(1) National development projects are schemes designed, implemented, and financed by the central government for the overall development of Indonesia.

(2) Regional development projects are provincial schemes designed, funded, and implemented by the provincial

government and its agencies.

(3) Special development projects are particular development projects which provide direct assistance from the national government to the provincial government.

Planning Agencies and the Planning Process

Planning agencies

BAPPENAS is the national agency responsible for the coordination of the sectoral planning activities of various government departments within the overall framework of the National Five-Year Plan.

BAPPEDA (Regional Development Planning Board) is a regional agency which assists the governor or head of the region in formulating development policies and in evaluating their implementation. The provincial authorities (governors, regencies, and municipal heads) are responsible vertically to the Department of Home Affairs.

UDKP (Local Development Working Unit) which is headed by a *Camat* (head of subdistrict region/*kecamatan*), is a form designed for creating a comprehensive system of programming, implementation, control, and evaluation of the performance of development works at the subdistrict level in the region (subdistrict region is one step higher than the village level).

Planning process

The planning process and its implementation proceed as follows:

(1) Plan formulation: At the national level, annual development project plans are prepared by each department sectorally; BAPPENAS has the task of combining these sectoral plans into a single cohesive national plan, and is also responsible for preparing the National Five-Year Plan.

At the provincial level, development project plans are prepared annually by the regional *dinas* (provincial government departments) and vertical agencies. BAPPEDA has the task of combining these sectoral plans into a single cohesive provincial plan.

(2) Plan appraisal: At the national level, the Parliament must ultimately approve national development plans before they are executed.

At the provincial level, the Provincial Parliament must appraise provincial development plans before they are forwarded to the Department of Home Affairs.

(3) Plan execution: Plans are executed by the various departments (including the provincial vertical agencies); regional project control at the provincial level is undertaken by the Directorate of Development (Governor's Office).

(4) Evaluation of results: BAPPENAS and BAPPEDA are responsible for the evaluation of the final results and achievements of an implemented plan.

Urban and Regional Planning Agency

The Department of Home Affairs is technically responsible for city and regional planning and development, but the task of "physical" planning, however, is delegated to the Ministry of Public Works, specifically the Directorate General of Housing, Building, and Urban Planning (*Direktorat Jenderal Cipta Karya*/DJCK). At the provincial level, historically, DJCK has sent teams from the central office at the Department in Jakarta to the provinces to gather data and then return to Jakarta to complete the study. DJCK then formulates a plan for the establishment of "planning units" in each of the provinces.

The planning unit assists both the provincial office of the Ministry of Public Works and the Office of the Governor in the task of city and regional planning. The first planning unit was established in the Province of Bali in 1969 as a pilot project and since then project teams have been trained and planning units have been established in twenty-six other provinces of Indonesia.

PURPOSE OF THE PROJECT

Projection of Population and Demand for Food

Indonesia is an archipelago with over 13,000 large and small islands. The length of the archipelago is approximately 5,113 km from east to west and the width is 1,820 km with a total land area of 1,919,335 km^2.

Based on the 1980 population census, the rate of population increase in Indonesia during the decade from 1970 to 1980 was as high as 2.32 per cent annually. With the government implementing a programme of family planning, it is expected that after 1980 and up until 1990, the rate of population growth will drop to around 2.0 per cent annually, and that by the year 2000, it will have dropped further.3/

Table 9.1 shows the projection of Indonesia's population to the year 2000. In Java and Madura the total population will reach approximately 130.2 million (59 per cent of the total population), which would mean a population density in these islands of 985 people per km^2. In other islands around Java, usually called the "outer islands," the population density will be less than 100 persons per km^2, because of its greater area.

Based on this projection of population in the year 2000, it is possible to project the total food requirements for this population. For the amount of food required, the quantity of rice representing an average daily intake was calculated.4/

TABLE 9.1. POPULATION PROJECTION OF INDONESIA, 1980-2000 (IN MILLIONS OF PEOPLE)

Island	1980	1985	1990	1995	2000	Area	Population density per km^2
Java/Madura	99.6	100.5	109.8	119.2	130.2	132,322	985
Sumatra	28.1	33.0	38.5	44.5	48.8	473,606	103
Sulawesi	10.5	11.6	12.8	14.1	16.0	189,216	85
Nusa Tenggara	8.5	9.3	10.1	11.2	12.8	88,488	145
Kalimantan	6.8	7.8	9.0	10.0	10.9	539,460	20
Maluku and Irian Jaya	2.6	3.0	3.3	3.7	4.1	496,486	9
Indonesia	148.1	165.2	183.5	202.8	222.8	1,919,443	116

Source: Bureau of Statistics.

Table 9.2 shows a total 24,000 tons of milled rice production in Indonesia, in 1983. From table 9.2 it is clear that Java contributed 14.7 thousand tons (61.3 per cent) and the outer islands 9.3 thousand tons (38.7 per cent), and in the year 2000, based on the projected population, the demand for milled rice is estimated to total 37.8 thousand tons of milled rice, with Java contributing 19.0 thousand tons (50.3 per cent), and the outer islands 18.8 thousand tons (49.7 per cent).5/ The contribution of total milled rice from the outer islands will increase from 38.7 per cent in 1983 to 49.7 per cent in the year 2000. By calculating various components such as agrotechnology and infrastructure development (irrigation networks, roads, etc.) in the outer islands, the need for an additional 3,000 ha of rice fields can be projected.

TABLE 9.2. PROJECTION OF RICE MILLED AND RICE PADDY SIZE

	Rice production (million tons)		Paddy field (million ha)	
	1986	2000	1983	2000
Java	14.707 (61.3 per cent)	19.008 (50.3 per cent)	4.779 1988 (5.100)	4.800
Outer Islands	9.299 (38.7 per cent)	18.792 (49.7 per cent)	3.960	6.960
Total	24.006	37.800	8.739	11.760

Source: Teken, 1986.
Note: In 1988, rice paddy size in Java equals 5.1 million ha.

Instrument for Data Handling and Planning

To select a sufficient area of agriculturally suitable land from the outer islands and for the monitoring of agricultural land in Java, an integrated data gathering system is needed. This system consists of (a) remote sensing techniques (as a tool for data collection); and (b) a computer system (as a tool for data processing), based on the concepts presented by H. A. Tubagus.6/

To develop this integrated system for supporting regional agricultural development planning, a project on the use of remote sensing in engineering (R/S project) was established by the

Ministry of Public Works with the technical cooperation of Japan in 1980.

FUNDING FOR THE PROJECT

To implement the remote sensing project, the Japanese Government provided a grant to cover the cost of equipment, machinery, expert personnel, as well as training in Japan to the tune of ¥461 million (approximately US$3 million in 1987 prices). As a counterpart grant, the Indonesian Government, through the Ministry of Public Works, prepared a budget covering building construction and materials, operation costs, commissions, and salaries. The value of this counterpart grant was Rp. 2,205,939. Detailed budget allocations are shown in table 9.3.

SYSTEM DESCRIPTION

Basic Concepts

The system of the remote sensing project has the following three functions:

(1) Data production: This function produces data necessary for land resource analysis and land resource evaluation, and consists of two activities. One is the production of various kinds of thematic maps using remote sensing data, which are then transformed to various levels of scale. The other activity is the transforming of existing image data (topographic maps and other thematic maps) or nonimage data (statistical data) to grid-cell data, and the making of computer data files.

(2) Data management: The thematic maps are stored in the form of a computerized data base, utilizing the Universal Transverse Mercator (UTM) projection system (see figure 24).

(3) Planning support: A planner evaluates land resources by consulting with the system. The system is effective in increasing the planner's ability, and the output of a plan will be given as a map and statistical data.

A diagram of the integrated system of data processing is shown in figure 25.

TABLE 9.3. BUDGET ALLOCATIONS FOR REMOTE SENSING PROJECT

From Indonesia

(Rp. 000)

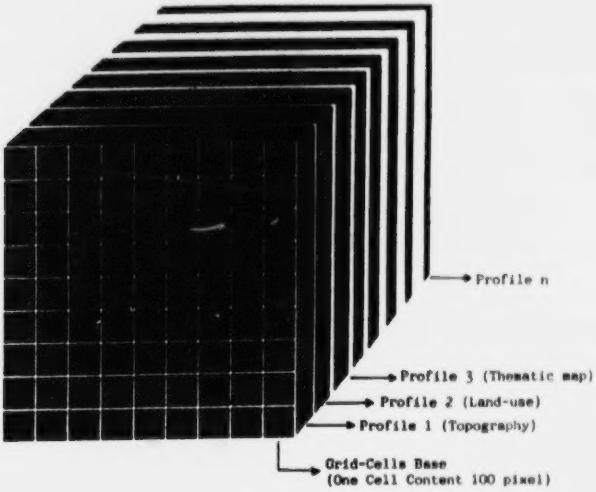
No.	Item	Budget Year							
		1980-81	1981-82	1982-83	1983-84	1984-85	1985-86	1986-87	Total
1.	Building	239,079	-	-	-	-	-	-	239,079
2.	Material Consumption	8,750	15,500	24,250	22,452	50,822	53,905	38,380	214,059
3.	Operation	322,805	212,264	234,503	174,558	100,510	91,320	93,561	1,229,521
4.	Commissions	-	88,000	123,000	53,400	74,660	98,520	85,700	523,260
5.	Salaries	per/mo.	per/mo.	per/mo.	per/mo.	per/mo.	per/mo.	per/mo.	per/mo.
	Total	570,634	315,764	381,753	250,410	225,992	243,745	217,641	2,205,939

From Japan

(¥000)

No.	Item	Budget Year							
		1980-81	1981-82	1982-83	1983-84	1984-85	1985-86	1986-87	Total
1.	Equipment and Machinery	56,265	247,090	79,943	25,254	20,000	15,000	18,000	461,552
2.	Experts	-	per/mo.	per/mo.	per/mo.	per/mo.	per/mo.	per/mo.	per/mo.
3.	Training Acceptance	per/mo.	per/mo.	per/mo.	per/mo.	per/mo.	per/mo.	per/mo.	per/mo.
	Total	56,265	247,090	79,943	25,254	20,000	15,000	18,000	461,552

Figure 24. Data Base Profile


Profile n
Profile 3 (Thematic map)
Profile 2 (Land-use)
Profile 1 (Topography)
Grid-Cells Base
(One Cell Content 100 pixel)

Main Features of the System

The main features of this system involve the overlaying of various types of thematic data on each other within a standard reference system. By manipulation of data and analysis of the spatial information from the data base, a "landscape model" of a region may be considered for defined uses of land.

The stages in the development of a "landscape model" are as follows:

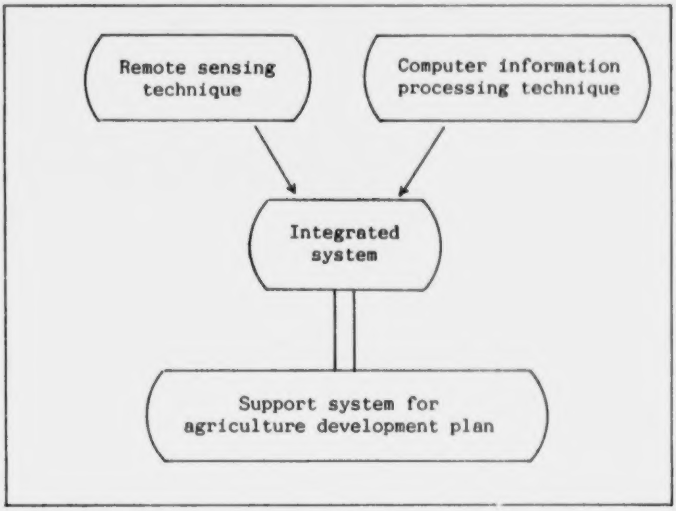
(1) Data preparation: Satellite data and other thematic maps are transferred into a "data file" as "regional data base" or geographic information system.

(2) Data processing: Preprocessing of geographical data is carried out, which involves data transformation, statistical calculation, and others.

(3) Data analysis and production of evaluation map: Several land evaluation methods, such as PATTERN and RANKING, are used to produce evaluation map according to the purpose of analysis.

The main framework of the system is shown in figure 26.

Figure 25. Basic Concepts of the System


Remote sensing technique
Computer information processing technique
Integrated system
Support system for agriculture development plan

Integrated system for supporting agricultural development plan.

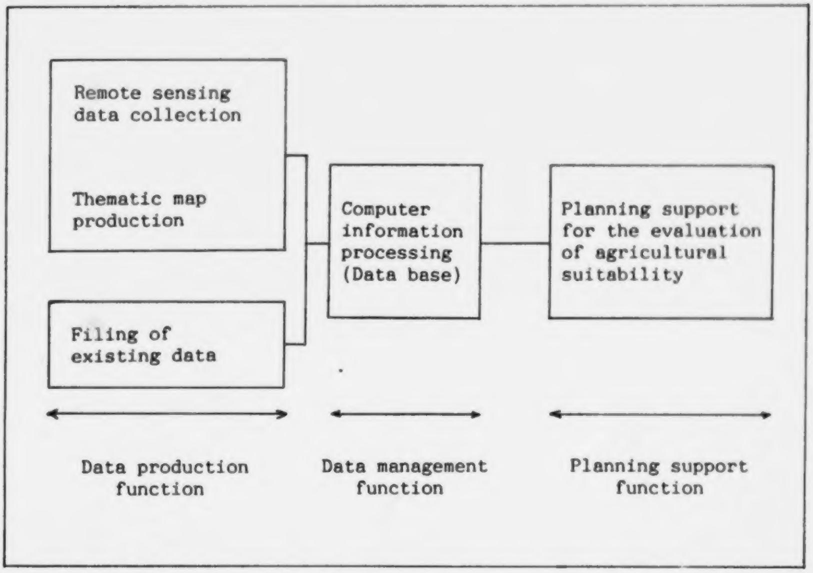
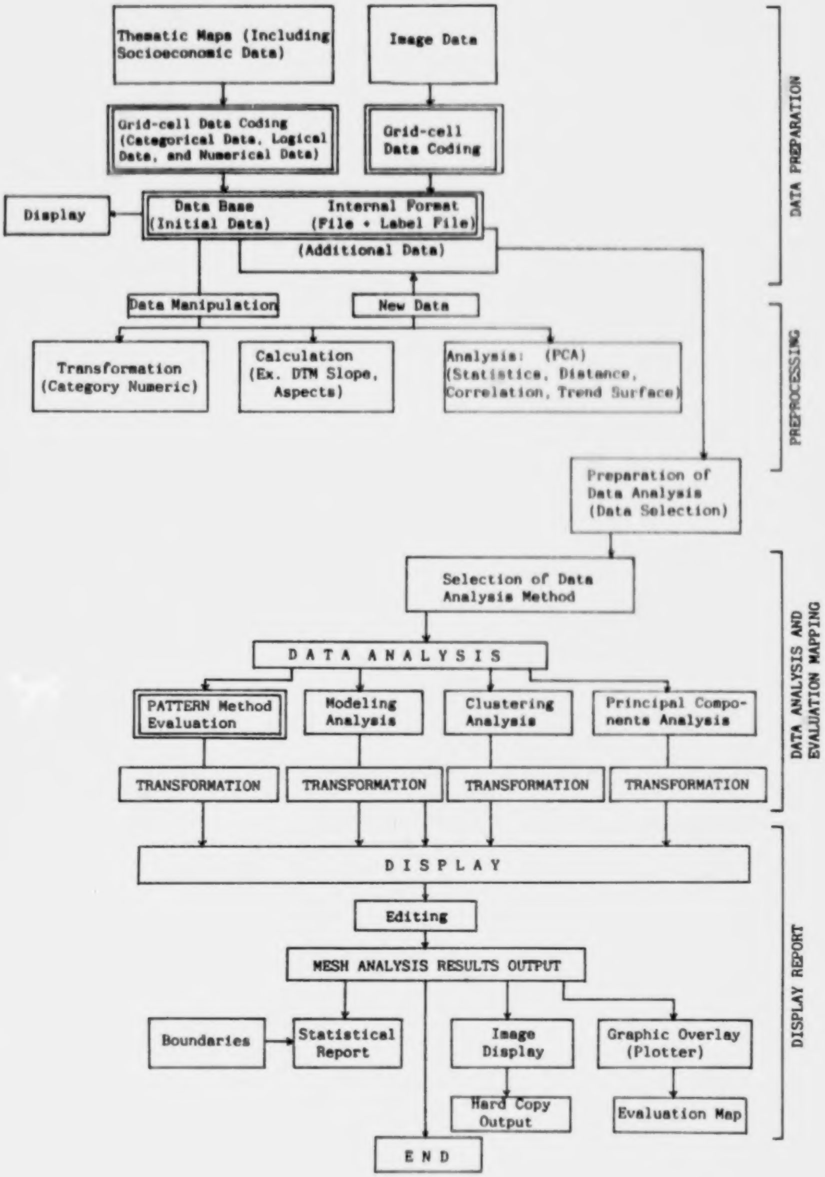

Remote sensing data collection
Thematic map production
Filing of existing data
Computer information processing (Data base)
Planning support for the evaluation of agricultural suitability
Data production function
Data management function
Planning support function

Figure 26. Concept and Basic Framework of Evaluation Mapping Using a Lanscape Model Data Base


Thematic Maps (Including Socioeconomic Data)
Image Data
Grid-cell Data Coding (Categorical Data, Logical Data, and Numerical Data)
Grid-cell Data Coding
Display
Data Base (Initial Data)
Internal Format (File + Label File)
(Additional Data)
Data Manipulation
New Data
Transformation (Category Numeric)
Calculation (Ex. DTM Slope, Aspects)
Analysis: (PCA) (Statistics, Distance, Correlation, Trend Surface)
Preparation of Data Analysis (Data Selection)
Selection of Data Analysis Method
DATA ANALYSIS
PATTERN Method Evaluation
Modeling Analysis
Clustering Analysis
Principal Components Analysis
TRANSFORMATION
TRANSFORMATION
TRANSFORMATION
TRANSFORMATION
DISPLAY
Editing
MESH ANALYSIS RESULTS OUTPUT
Boundaries
Statistical Report
Image Display
Graphic Overlay (Plotter)
Hard Copy Output
Evaluation Map
END
DATA PREPARATION
PREPROCESSING
DATA ANALYSIS AND EVALUATION MAPPING
DISPLAY REPORT

)

REMOTE SENSING SYSTEM AND DIGITAL PROCESSING

Establishment of the System

Technology transfer

The transfer of advanced technology, such as remote sensing technology and digital data processing, from foreign experts to their Indonesian counterparts, was done by two methods. Firstly, through the adoption of a total system, to install the project, and secondly, through a process of learning-by-doing. These methods were effective.

During the seven years of project execution the Japanese Government allocated approximately 200 man-weeks of short-term experts, which include experts in various fields from various institutions in Japan.

Additionally, long-term experts (eight man-years) were also made available, who took charge of project execution and set up the agricultural development and systems planning.

Over a period of seven years, all seventeen project personnel were trained in Japan for forty man-months in several fields. The scope of the transfer of technology was classified into operational, theory, and application.

The levels of effectiveness of the technology transfer are shown in tables 9.4 and 9.5.

System development

To effectively implement the system a "training area" was established to help achieve land resource analysis and evaluation with the image processing method which will provide the necessary data for selecting a suitable area to be developed and for implementing the system more smoothly.

The system, which has already been developed in the "training area," will be implemented in the "case study area," as an area where the image processing method will be applied to the actual process for land resource evaluation for the agricultural infrastructure development plan.

Results from the two processes were set up as an established system and further steps will be implemented in other areas in Indonesia.

TABLE 9.4. TECHNOLOGY TRANSFER CONDITION OF COUNTERPARTS

A: High level
B: Middle level
C: Low level

	Item	October 1986		
		Operation	Theory	Application
Darkroom Processing	Colour Balance	A	A	A
	Setting up printer scale	A	A	A
	Quality control of developer	A	A	A
Preprocessing	Format Conversion	A	A	A
	Noise Reduction	A	B	A
	Geometric Correction	A	A	A
	Scale enlarging	A	A	A
	Image enhancement	A	A	A
	Mosaic of image	A	A	A
	Clustering	A	A	A
	Most likely image	A	B	A
	Principal component method	A	B	A
	CRT display	A	C	A
	Photoscanner	A	B	A
	Photoprinter	A	B	A
	X-Y plotting	A	A	A
	Digitizer	A	A	A
Thematic Map Processing	False colour image	A	A	A
	Land cover map	A	A	A
	Biomass classification map	A	B	A
	Soil moisture map	A	B	A
	Soil colour	A	B	A
	Geological map	A	A	A
	Geomorphological map	A	A	A
	Drainage pattern map	A	A	A
	Thematic Map from multi-temporal data	A	A	A
	Digital data making from existing map	A	A	A
Land Evaluation Process	Model for suitable land selection	A	A	A
	Criterion of evaluation	A	A	A
	Production of evaluation map	A	A	A

TABLE 9.5. EVALUATION OF PERSONNEL ABILITY IN USING HARDWARE SYSTEM

HARDWARE \ ABILITY	OPERATION	REPLACEMENT SPARE PARTS	MAINTENANCE/REPAIRING MECHANICAL SYSTEM	MAINTENANCE/REPAIRING ELECTRIC/ELECTRONIC SYSTEM	OTHERS
1. Spectral reflectance meter	A	B	B	B	
2. Stereo zoom transferscope	A	B	B	B	
3. Additive colour viewer	A	B	B	B	
4. Colour paper processor	A	B	B	B	
5. Photo enlarging system	A	B	B	B	
6. Photoprinter	A	B	B	B	
7. Photoprinter controller	A	B	B	B	
8. Colour display	A	B	C	B	
9. Drum scanner	A	B	C	B	
10. D-Scan system	A	B	B	B	
a. D-Scan plotter					
b. Digitizer					
c. Character display					
d. Magnetic tape unit					
e. Graphic display					
11. Photo typesetter	D	D	D	D	

Costs and Benefits of the System

In the master planning stage of a project, a cost/benefit analysis must be conducted to determine whether or not that project should be implemented, but in the case of the "Remote Sensing in Engineering Project," such a step was not followed due to some considerations, as follows:

(1) In the master plan of a physical development programme, sequential stages of work should be carried out such as survey and investigation; design; construction; operation and maintenance (SIDCOM), in order to produce a useful result.

The end results of the "Remote Sensing in Engineering Project," are a map and statistical data to be used during the stages of survey, investigation, and design, or as a tool for monitoring the physical development project during the stages of operation and maintenance.

Therefore, it is very difficult to calculate the benefit related to a physical development project and also the investment cost of the "Remote Sensing in Engineering Project."

(2) The end result of the "Remote Sensing in Engineering Project" is very difficult to translate into monetary terms because the data and maps are uncountable but the term "value" is a more accurate description for the output of a remote sensing project, e.g., good maps, recent maps, and up-to-date data, for extending support to other activities.

(3) "Remote Sensing in Engineering Project" is of a governmental investment type, which has a duty to service and provide data/information to other agencies. However, the economic evaluation of this project was carried out using the terms "with" the project and "without" the project.

In many instances the data and maps required by planners to formulate a physical development project in a master plan have not been collected yet.

As a result, the time and expenditure needed to carry out planning studies are considerably increased in many cases because basic data has to be collected in the field. This situation is termed "without project." After the "Remote Sensing in Engineering Project" was installed, the problem could be solved in a few months.

The resulting situation is called "with project."

In the formulation of a regional planning master plan for the island of Sumbawa in Indonesia, a land-use map is required and by using conventional mapping methods only three-fourths of the area of the island was mapped in three years, but when the remote sensing method was employed all areas of the island were mapped in two months.

Advantages of the System

(1) Data handling and storage

The systems using computers are demonstrably powerful tools for management and analysis of spatial data, manipulating and displaying very large volumes of geographically referenced data.

If the system does not use a computer, serious difficulties will be encountered due to:

(a) The volume of data to be processed being so large, manual methods are incapable of completing the task.

(b) The manipulation was sufficiently complex, that when coupled with the large data columns, the task could not be completed without substantial error. A computer system is capable of solving the error.

(2) Compatibility and reliability of data

The planner and the decision maker should be able to quickly assess what data is stored and the required data should be easily retrieved. Data from various agencies must be accurate and in a compatible format.

The remote sensing project facilitated compatibility, reliability, and accuracy of data to accommodate the requirements of planners and decision makers.

(3) Investment costs

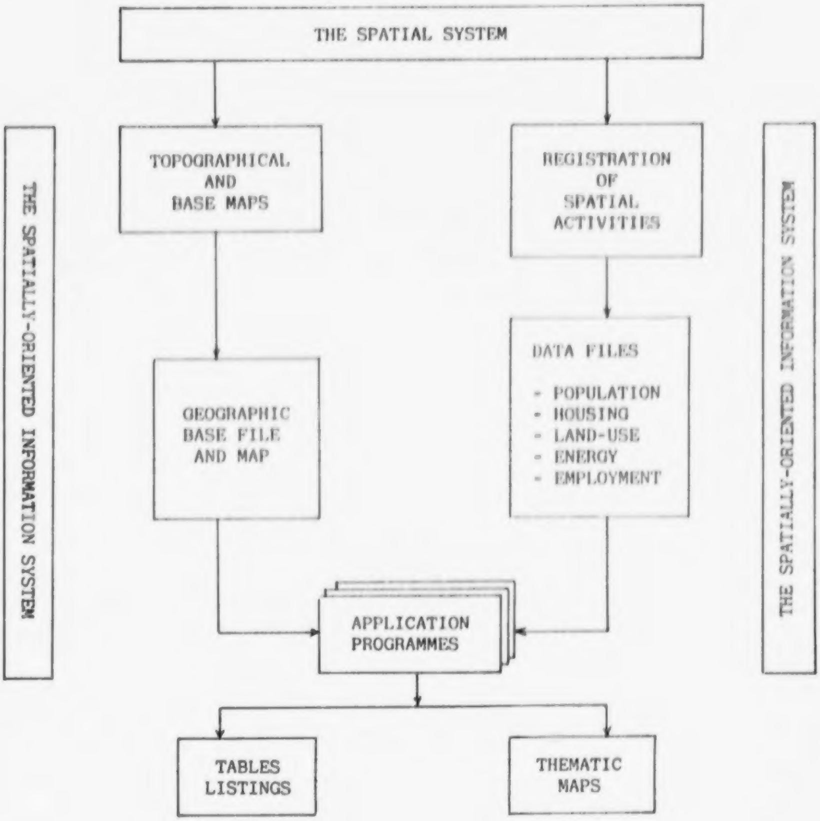
In developing countries, projects like the remote sensing project are relatively expensive, because a computer-based integrated planning for data bank establishment in a developing country can only be done at huge costs.

REMOTE SENSING SYSTEM AND DIGITAL PROCESSING

Development of the System

The remote sensing project provides information on the physical characteristics of the area for regional/urban development planning. A region is characterized not only by its physical infrastructure but also by its activities and its relationships, both intraregional and interregional. The decision support system should be as integrated as is practical.7/ Figure 27 shows the basic structure and the connections between data items.

Figure 27. A Representation of Spatially-Oriented Information System


THE SPATIAL SYSTEM
TOPOGRAPHICAL AND BASE MAPS
REGISTRATION OF SPATIAL ACTIVITIES
GEOGRAPHIC BASE FILE AND MAP
DATA FILES
- POPULATION
- HOUSING
- LAND-USE
- ENERGY
- EMPLOYMENT
APPLICATION PROGRAMMES
TABLES LISTINGS
THEMATIC MAPS
THE SPATIALLY-ORIENTED INFORMATION SYSTEM
THE SPATIALLY-ORIENTED INFORMATION SYSTEM

REMOTE SENSING SYSTEM AND DIGITAL PROCESSING

In the near future, the remote sensing project's task will be to improve the system, to facilitate the incorporation of other structural data/information in a data base system.

Figure 28 shows the new concept of the remote sensing project in the future.

HARDWARE REQUIREMENT, SOFTWARE OPERATION, AND APPLICATION

Hardware Configuration

The remote sensing project has two groups of data processing facilities, first is an analogue equipment and second is a digital equipment. The equipment configuration is as follows:

(1) Information and image data processing facilities

An IBM 4341 computer has already been installed to provide an image processing system (IPS). In addition, this facility can also be used to process other data in accordance with its function as a "digital processing system."

(2) Graphic information processing function

A Data General NOVA-4 computer is also provided to convert analogue data into digital data by means of a digitizer system. In addition, this system can also be used to produce graphic maps by the use of a plotter.

(3) Photo processing function

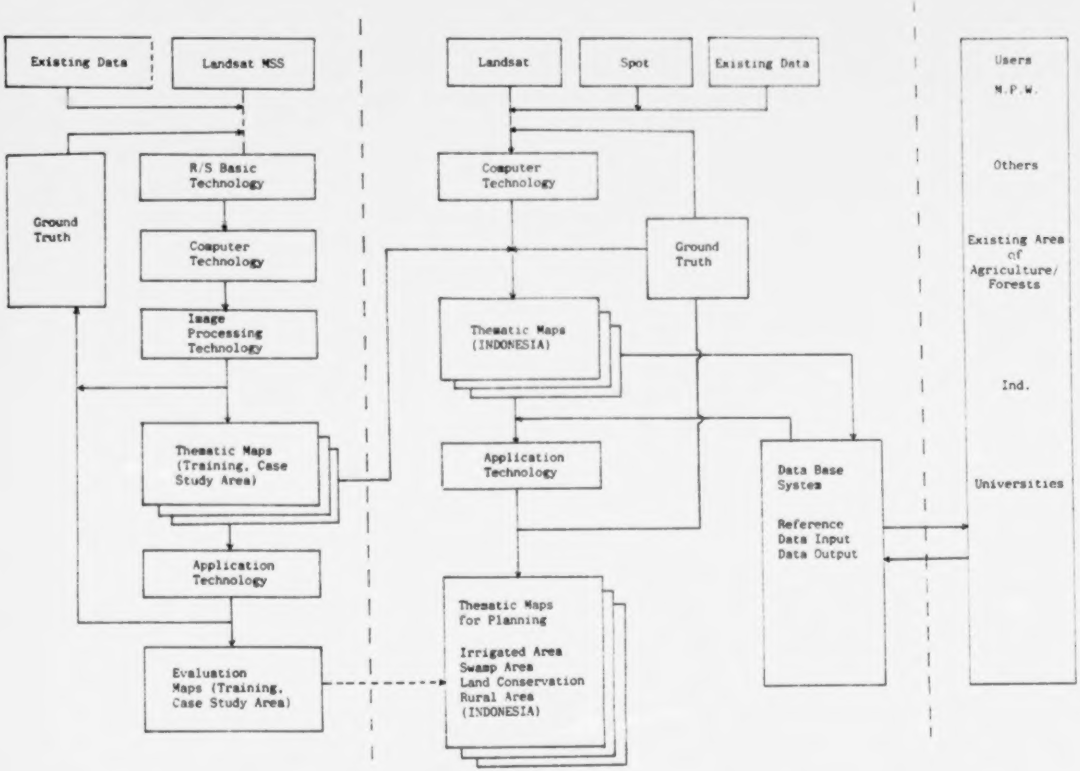
Results of satellite and other thematic data analysis can be presented in colour photograph form.

(4) Photo interpretation function

Photo interpretation of either aerial or satellite images which should be carried out in the analogue system due to spatial pattern arrangement, has to be taken into account.

Photo analysis is performed with the aid of an additive colour viewer in order to enhance the photo interpretability.

Figure 28. Future Development of R/S Project


Existing Data
Landsat MSS
Ground Truth
R/S Basic Technology
Computer Technology
Image Processing Technology
Thematic Maps (Training, Case Study Area)
Application Technology
Evaluation Maps (Training, Case Study Area)
Landsat
Spot
Existing Data
Computer Technology
Ground Truth
Thematic Maps (INDONESIA)
Application Technology
Thematic Maps for Planning
Irrigated Area
Swamp Area
Land Conservation
Rural Area
(INDONESIA)
Data Base System
Reference
Data Input
Data Output
Users
M.P.W.
Others
Existing Area of Agriculture/ Forests
Ind.
Universities

(5) Ground truth function

Radiometric field data can be obtained by using a "spectro radiometer." Target reflectivity is measured and compared to the total reflectiveness of the white board. Measurement is carried out in visible, near infrared, and infrared wavelengths, as well as through satellite data.

Afterwards, the result of measurement is transformed into a spectral pattern, in order to compare it with the spectral pattern which is obtained by satellite sensor. Correlation between satellite data and field data can be normally obtained.

(6) NEC personal computer

NEC PC-9801 VM hal which has been installed since 1986 has not yet become fully operational as there is no expert in charge of it. At the beginning of 1987, JICA dispatched experts to handle this machine, enabling processed satellite data, and other thematic maps to be used.

Hardware configurations can be seen in figures 29 and 30.

Software Configuration

(1) Mainframe software configuration

A software called Productive Remote Sensing System (PRESS) has been developed. This software is product characteristic-oriented, which is composed of: remote sensing image processing function; graphic data processing function; data management system; and planning support function.

The PRESS system is a software combination of the Expert Product Organic Component (EPOC), the Laboratory for Application of Remote Sensing System (LARSYS) produced by Purdue University, and the Advanced Remotely Sensed Integrated System (ARIS). Mainframe software system configuration can be seen in figure 31.

(2) Personal computer software configuration

Personal computer software configurations are provided by Kimoto Tiny System, Lodia, Ippx. Regional Statistical Analysis System and NEC System.

Figure 29. Hardware Configuration

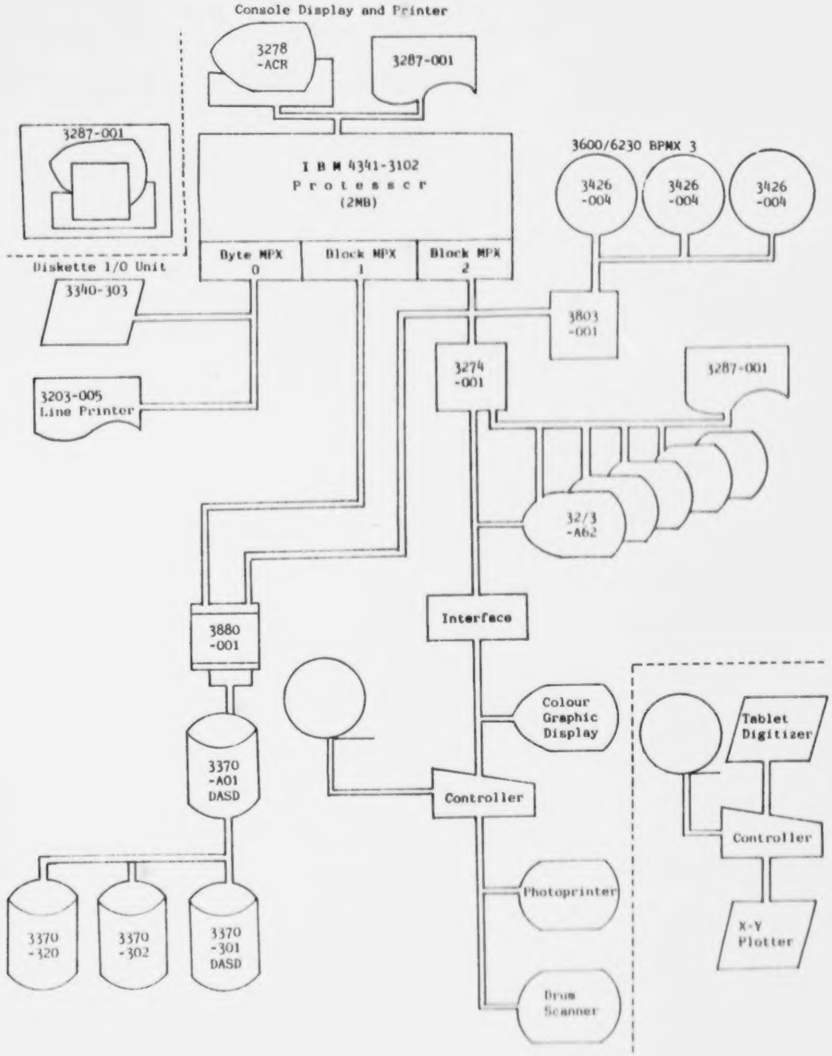
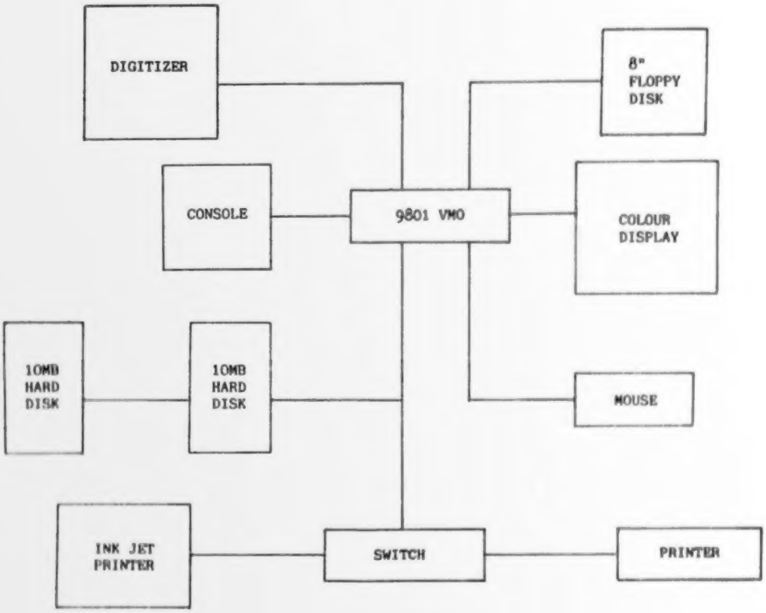

Console Display and Printer
3278 -ACR
3287-001
3287-001
Diskette I/O Unit
I B M 4341-3102 Processor (2MB)
Byte MPX 0
Block MPX 1
Block MPX 2
3600/6230 BPMX 3
3426 -004
3426 -004
3426 -004
3340-303
3203-005 Line Printer
3803 -001
3274 -001
3287-001
3273 -A62
Interface
3880 -001
3370 -A01 DASD
Colour Graphic Display
Controller
Tablet Digitizer
Controller
Photoprinter
X-Y Plotter
Drum Scanner
3370 -320
3370 -302
3370 -301 DASD

Figure 30. Hardware Configuration of NEC Personal Computer 9801 VM


DIGITIZER
8" FLOPPY DISK
CONSOLE
9801 VMO
COLOUR DISPLAY
10MB HARD DISK
10MB HARD DISK
MOUSE
INK JET PRINTER
SWITCH
PRINTER

DEVELOPMENT OF DATA BASE

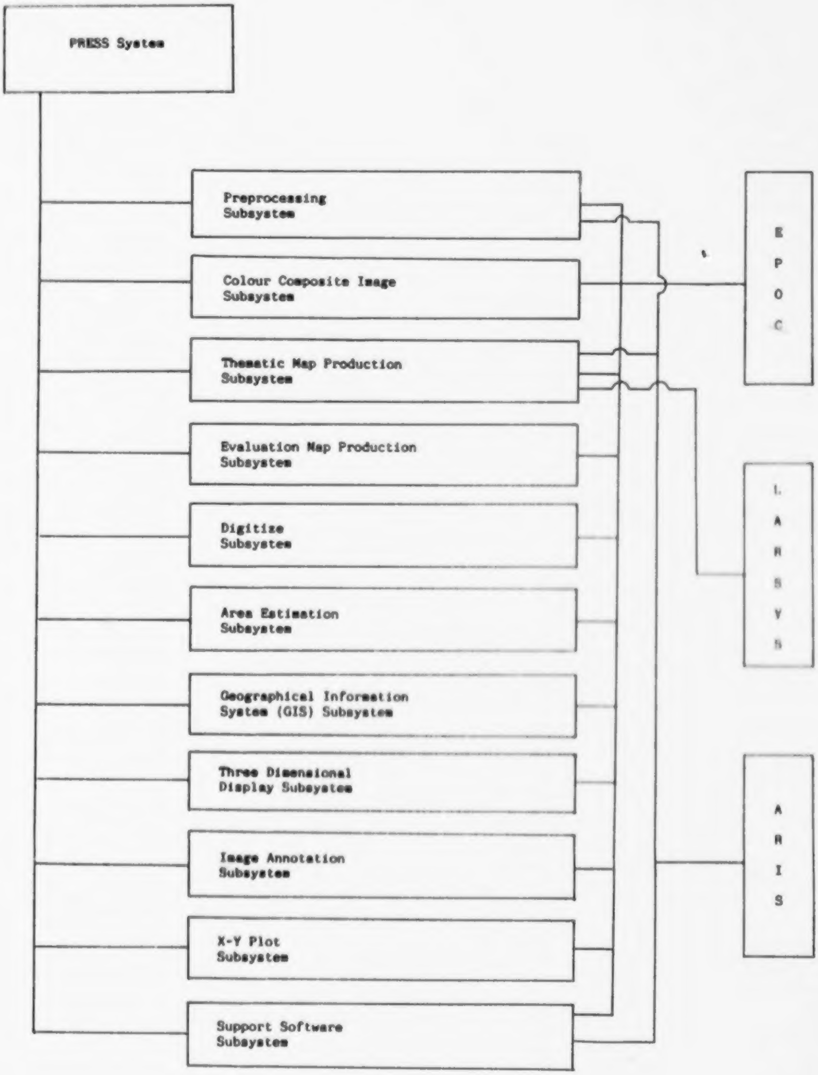
Data Base Management

The management information system for spatial planning and decision making (regional planning and urban planning) is a spatially-oriented information system based on the simultaneous actions of various information sources. Such an information system can only be developed by integration of both maps (topography and thematic maps) and data files.8/ Figure 27 shows a representation of a spatially-oriented information system.

The remote sensing project used a spatial information system as a tool for data handling and data base management with the following considerations:

(1) The volume of data to be handled in the spatial orientation and regional inventories, i.e., administration area/boundary, natural and ecological unit (catchment area), can be stored by using a system of grid-cells.

Figure 31. Software Coverage on PRESS System


PRESS System
Preprocessing Subsystem
Colour Composite Image Subsystem
Thematic Map Production Subsystem
Evaluation Map Production Subsystem
Digitize Subsystem
Area Estimation Subsystem
Geographical Information System (GIS) Subsystem
Three Dimensional Display Subsystem
Image Annotation Subsystem
X-Y Plot Subsystem
Support Software Subsystem
EPOC
LARSYS
ARIS

(2) The geographical files serve as the core of the information system. The digital landscape model organizes and overlays data from existing maps, socioeconomic data (census data), and remote sensing mapping (from satellite and airborne surveys) into a computer framework. This assembly provides a multivariate, multitemporal, mathematical model, which is representative of the landscape through the following steps:

(1) Grid-cell system

The landscape model is represented by a set of grid-cell sample data arranged in a sequence. The grid-cell size can be determined arbitrarily depending on the accuracy requirement at the planning stage. A sample of grid-cell size in Indonesia with various scales is shown in table 9.6.

TABLE 9.6. EXAMPLE OF GRID-CELL SIZE

No.	Areal extent	Map scale	Map scale	Stage order
1	Countrywise	1 : 1,000,000	1 - 5 km	1st order
2	Regional	1 : 250,000	500 m - 1 km	2nd order
3	Local	1 : 50,000	25 - 50 m	3rd order
4	Site	1 : 20,000	10 - 5 m	4th order
		1 : 5,000		

(2) Ground (geographical) coordinate system

A standard coordinate system is established as a reference for grid calculation so as to permit overlapping of necessary landscape modeling into one computer framework.

The Universal Transverse Mercator coordinate system is used in Indonesia with various grid-cell sizes, which are shown in figures 32, 33, and 34.

(3) Geocoding method

Geocoding is a procedure in which all maplike landscape model data in the grid-cell system are transformed into numbers (symbols) to enable data to be inputted and stored in the computer system. Three types of geocoding, namely, numerical, cate-

Figure 32. Index Grid-Zone Area Size 6° x 8°

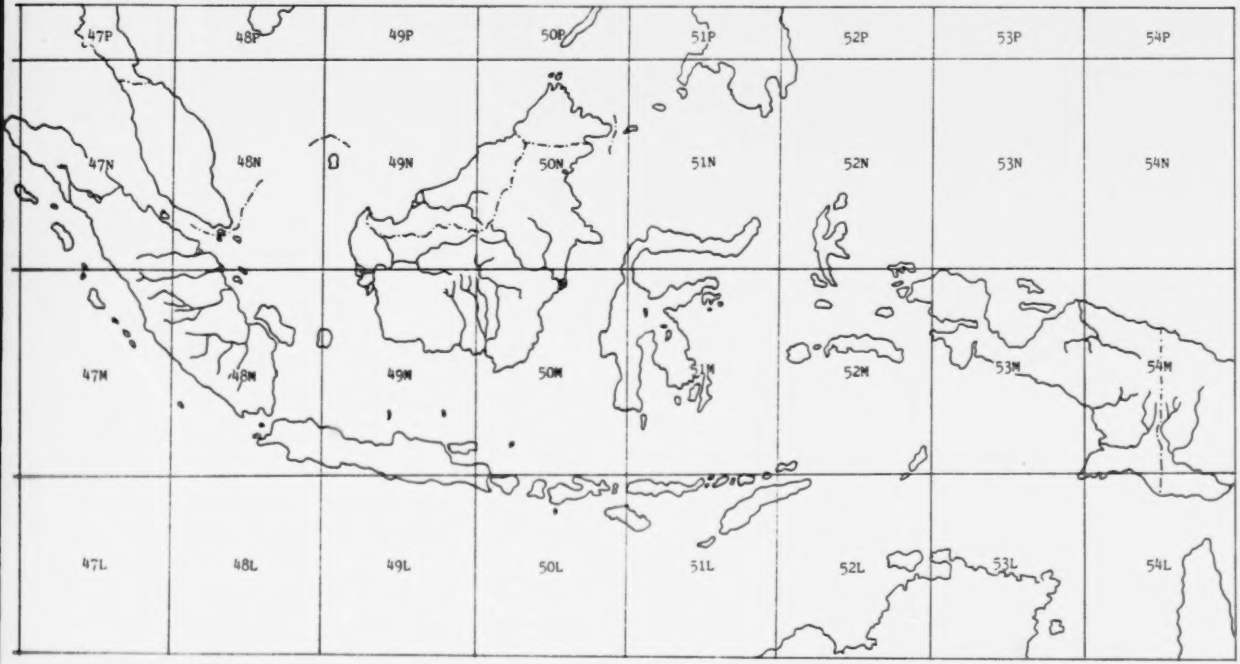
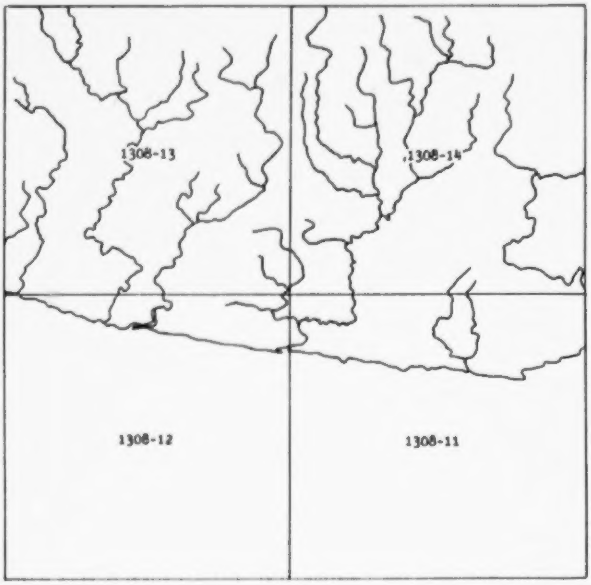

47P
48P
49P
50P
51P
52P
53P
54P
47N
48N
49N
50N
51N
52N
53N
54N
47M
48M
49M
50M
51M
52M
53M
54M
47L
48L
49L
50L
51L
52L
53L
54L

Figure 33. National Base Map



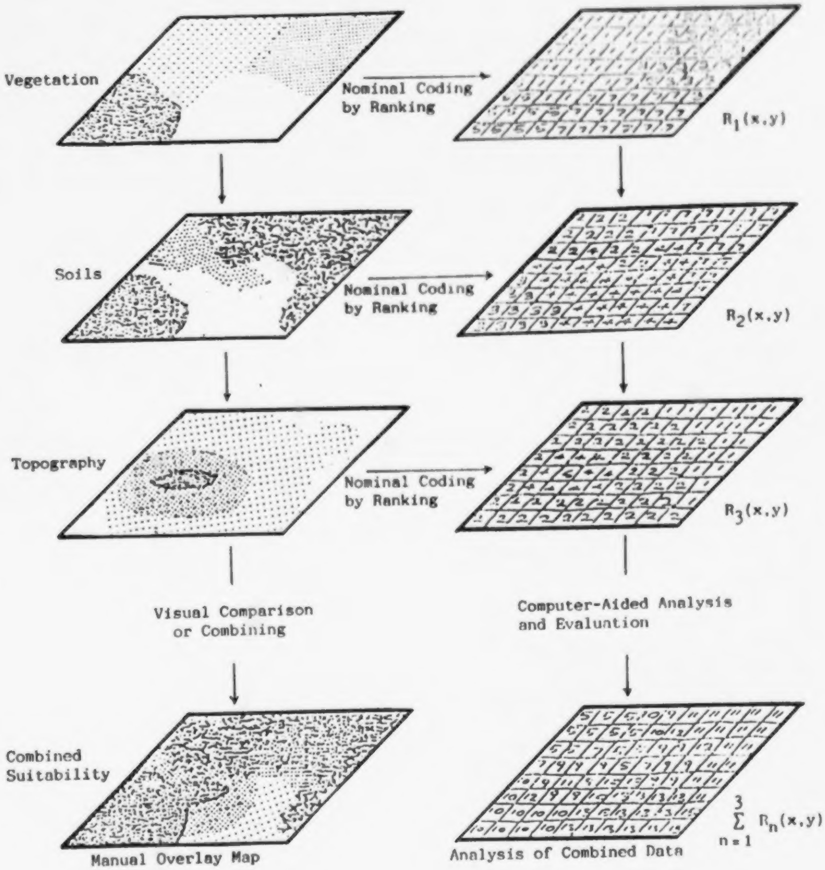
gorical, and logical, may be accomplished in order to make the geocoded data meaningful in the computer framework.

Typical examples of these original first stage landscape data (thematic data) are shown in figure 34.

Geocoded data of the landscape model are overlayed in the computer framework to form a data base.

Format of the data base has to be predetermined. In the present spatial analysis system, a data file format (called INTERNAL format), uses image processing system and conversion with the UTM coordinate system as the data base format, so that interfacing between the spatial data analysis system (thematic map) and the image processing system from satellite and/or airborne survey can easily be made, i.e., displaying, extraction, and enhancement can be shared by both systems.

Figure 34. A Simple Example of Integrated Analysis of Spatial Data (Concept)


Vegetation
Nominal Coding by Ranking
$R_1(x,y)$
Soils
Nominal Coding by Ranking
$R_2(x,y)$
Topography
Nominal Coding by Ranking
$R_3(x,y)$
Visual Comparison or Combining
Computer-Aided Analysis and Evaluation
Combined Suitability
Manual Overlay Map
Analysis of Combined Data
$\sum_{n=1}^{3} R_n(x,y)$

REMOTE SENSING SYSTEM AND DIGITAL PROCESSING

Data Collection Methods

Spatial data is collected periodically from the satellite (Landsat, Spot) in the form of Computer Compatible Tape (CCT), while temporary data (airborne) is gathered whenever a certain objective or necessity arises.

Four ground stations (Indonesia, Australia, Thailand, and the United States) are generally supplied with satellite data.

Data Analysis

Collected raw data is arranged and analysed according to the objective of the survey.. The data from regular collection is fed into a computer and systematically analysed for general use. The original format of raw data (pixel size) is changed to a new format in rectangular form, i.e., reformatting of Landsat MSS (Multi Spectral Scanner) data from the original pixel size during the preparation stage before being stored in the data base system.

Other data (topography, existing thematic map) were composed into a data base using a new format.

In urban and regional analysis, planning data analysis from a data base is directed towards identifying "landscape phenomena" for a defined use. The first output, called an "unsupervised" result, is then examined in the field.

Data processing continues after the field check and the final result, called a "supervised" result will be completed when the performance output is more than 75 per cent compared with other statistical data or existing maps.

Figure 35 shows a sample of the performance test of a classification process.

Method of Disseminating Information

The criterion for success in applying the output of the remote sensing project lies in the direct use of information by other agencies. To reach this success, definitions are needed on the requirements for supplying that information (interactive process).

Figure 36 describes the process of data management for users, i.e., planners and decision makers, together with the laboratory process.

Figure 35. Block Diagram of Image Classification

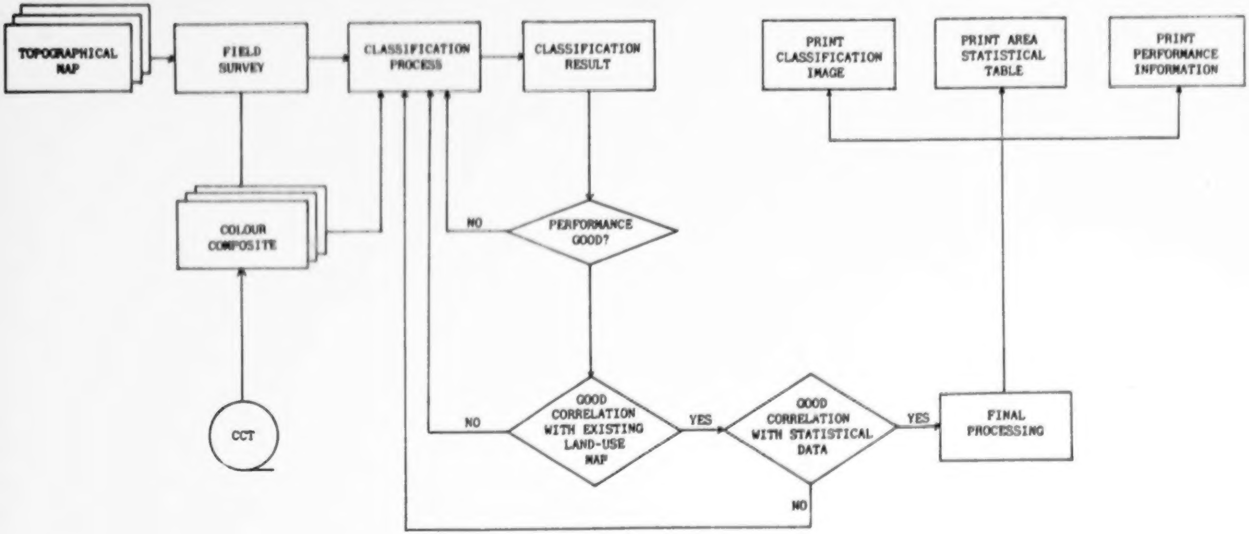
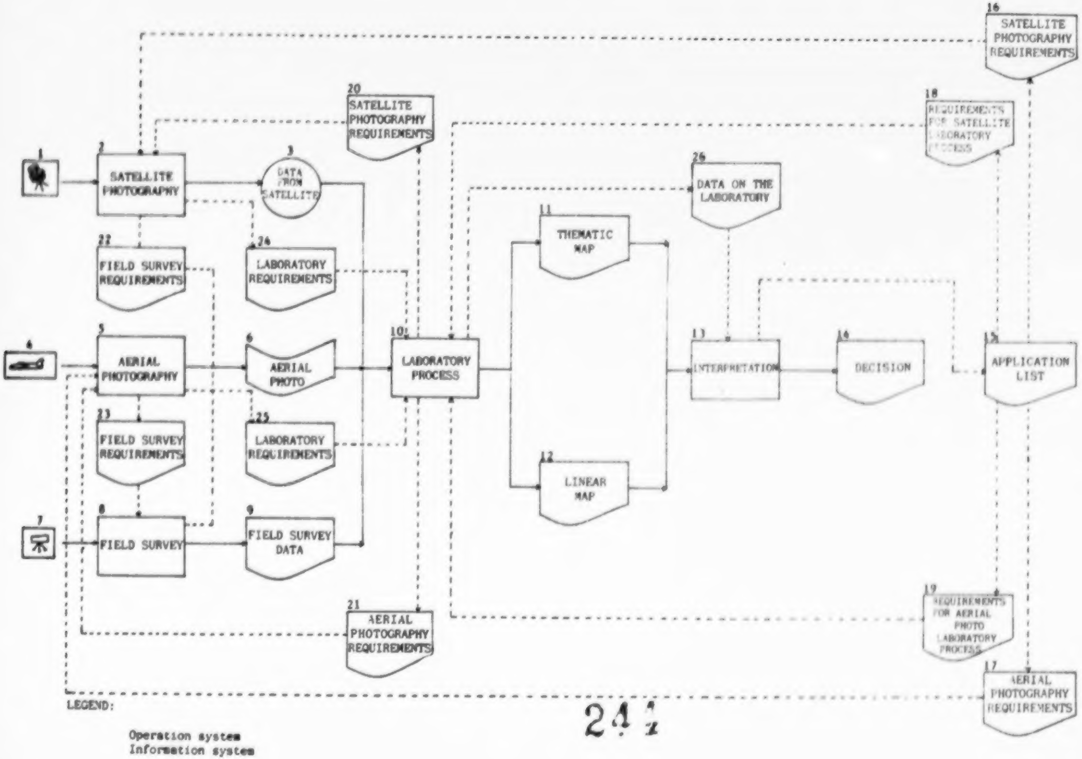

TOPOGRAPHICAL MAP
FIELD SURVEY
CLASSIFICATION PROCESS
CLASSIFICATION RESULT
PRINT CLASSIFICATION IMAGE
PRINT AREA STATISTICAL TABLE
PRINT PERFORMANCE INFORMATION
COLOUR COMPOSITE
NO
PERFORMANCE GOOD?
CCT
NO
GOOD CORRELATION WITH EXISTING LAND-USE MAP
YES
GOOD CORRELATION WITH STATISTICAL DATA
YES
FINAL PROCESSING
NO

Figure 36. The Management of Data


1
2
SATELLITE PHOTOGRAPHY
3
DATA FROM SATELLITE
4
5
AERIAL PHOTOGRAPHY
6
AERIAL PHOTO
7
8
FIELD SURVEY
9
FIELD SURVEY DATA
10
LABORATORY PROCESS
11
THEMATIC MAP
12
LINEAR MAP
13
INTERPRETATION
14
DECISION
15
APPLICATION LIST
16
SATELLITE PHOTOGRAPHY REQUIREMENTS
17
AERIAL PHOTOGRAPHY REQUIREMENTS
18
REQUIREMENTS FOR SATELLITE LABORATORY PROCESS
19
REQUIREMENTS FOR AERIAL PHOTO LABORATORY PROCESS
20
SATELLITE PHOTOGRAPHY REQUIREMENTS
21
AERIAL PHOTOGRAPHY REQUIREMENTS
22
FIELD SURVEY REQUIREMENTS
23
FIELD SURVEY REQUIREMENTS
24
LABORATORY REQUIREMENTS
25
LABORATORY REQUIREMENTS
26
DATA ON THE LABORATORY
LEGEND:
Operation system
Information system

SERVICES PROVIDED BY THE INFORMATION SYSTEM

The remote sensing project as a unit of the spatial information system, is one of the four service units at the Centre for Data Processing and Mapping. The Centre, in the Ministry of Public Works is responsible for supplying spatial information for urban and regional planning.

However, since the operations method has been established, the product is usually used for physical infrastructure planning. In the remote sensing project data production is the main function, while on the other hand the remote sensing project also accommodates training and research and development for other implementing agencies and universities.

Two Case Studies

Besides the achievement of the information system project, case studies covering the implementation of the system in certain areas may provide an illustration of how the system has been used in planning and monitoring. The first case study concerns agricultural land evaluation in Java and Madura islands. The study's goal was to evaluate land capability concerned with the present land performance for agricultural infrastructure development planning through the use of physical data.

Methods and Processing Procedure

In the analysis for agricultural development planning, satellite data was used as raw data. This was processed for preparing land cover and biomass maps, which will be combined with digitized maps from other existing thematic maps, i.e., soil maps, geological maps, slope maps (derived from topographical maps), rainfall maps, and administrative boundary maps (figure 37). The data base created from these maps has been processed in a grid-cell format.

Figure 38 shows the process of land evaluation and data analysis; the Planning Assistance Through Technical Evaluation of Relevant Number (PATTERN Method) was used for processing data from the data base. The result consists of two kinds of output, which are statistical in form, one of which is shown in table 9.7. The other is in photo form and not reproduced here.

Statistical figures in table 9.7, show that approximately 5,585,320 ha (TP-1, TP-2, TP-3) is very good for paddy fields, but in fact part of this area is usually occupied by cities.

Figure 37. Combination Data from Data Base for Land Evaluation

1. ELEVATION MAP

No.	Class	Relative Score
1.	0 - 50 m	99
2.	50 - 100 m	99
3.	100 - 300 m	80
4.	300 - 500 m	75
5.	500 - 1,000 m	50
6.	1,000 - 1,500 m	30
7.	1,500 m	10

2. SLOPE MAP

No.	Class	Relative Score
1.	0 - 8%	90
2.	8 - 15%	60
3.	15 - 40%	40
4.	40%	15

3. SOIL TYPE MAP

No.	Class	Relative Score
1.	Alluvial	90
2.	Gray Hydromorphic	90
3.	Andosol and Regosol	90
4.	Mediteran	50
5.	Limestone Regosol	75
6.	Coastal Regosol	75
7.	Basic Regosol	75
8.	Lithosol	10
9.	Basic Latosol	90
10.	Acid Latosol	90
11.	Red-Yellow Podsolic	60
12.	Podsolic Complexes	50
13.	Grumosol	75
14.	Red-Yellow Mediteran	70

4. GEOLOGICAL MAP

No.	Class	Relative Score
1.	Alluvium	90
2.	Young Volcanic Product	60
3.	Old Volcanic Product	99
4.	Undifferentiated Sedimentation Rock	40
5.	Limestone	10

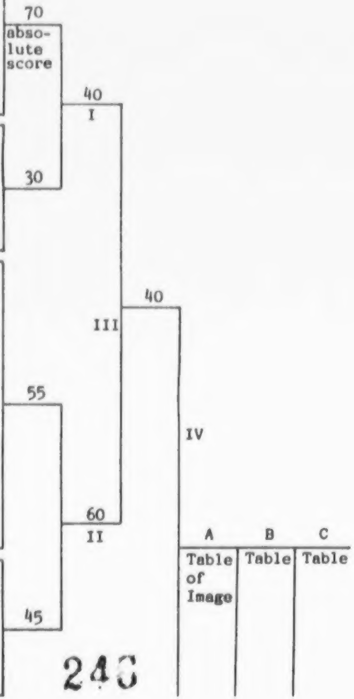


Figure 37. (Continued)

5. RAINFALL MAP

No.	Class	Relative Score
1.	1,500 mm/year	60
2.	1,500 - 2,000 mm/year	99
3.	2,000 - 2,500 mm/year	99
4.	2,500 - 3,000 mm/year	80
5.	3,000 - 3,500 mm/year	80
6.	3,500 - 4,000 mm/year	60
7.	4,000 - 4,500 mm/year	50
8.	4,500 - 5,000 mm/year	30
9.	5,000 mm/year	10

6. LAND COVER MAP

No.	Class
1.	Water Bodies
2.	Tambak/Fishpond
3.	Sawah/Paddy Field
4.	Shrub and Bush
5.	Mixed Garden
6.	Settlement
7.	Forest
8.	Dry Field
9.	Cloud Coverage
10.	Built-up Area

7. BIOMASS MAP

No.	Class
1.	0 - 6 kg/m^2
2.	6 - 11 kg/m^2
3.	11 - 15 kg/m^2
4.	15 kg/m^2

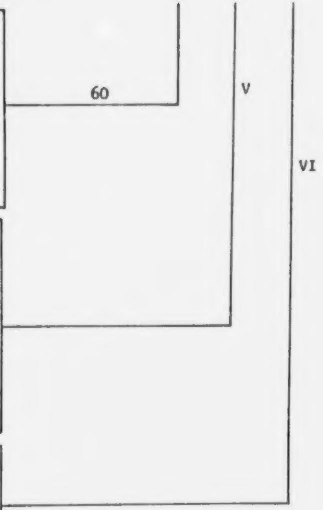


Figure 38. Evaluation Process

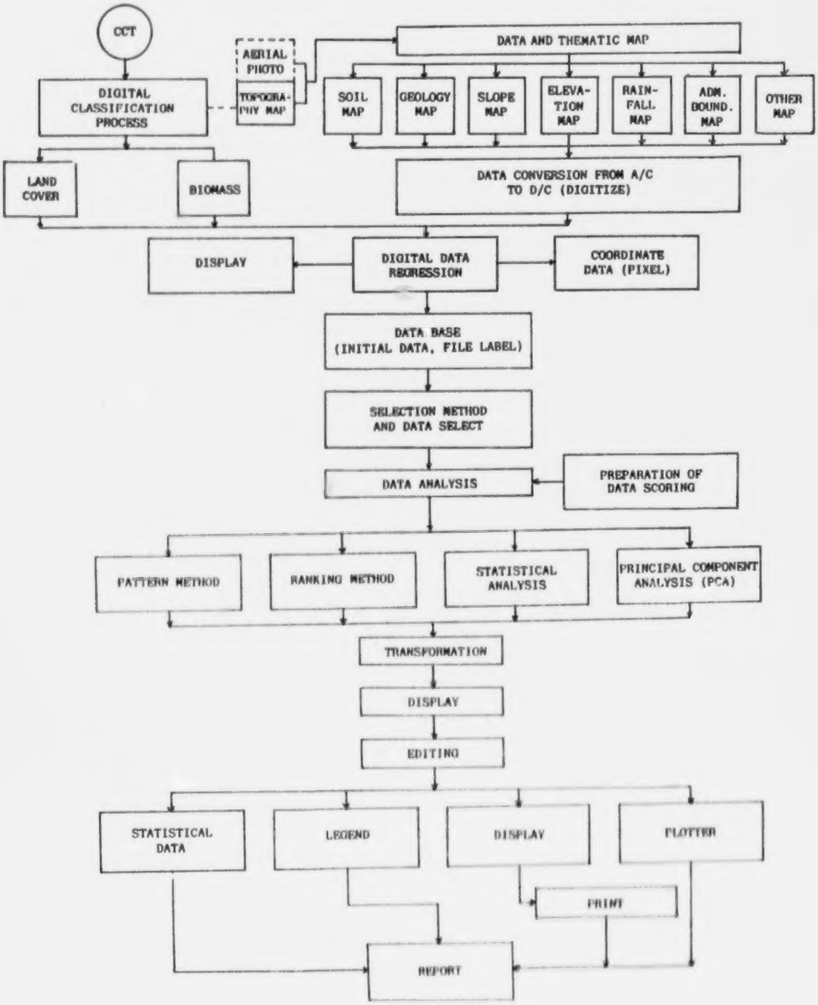

CCT
AERIAL PHOTO
TOPOGRAPHY MAP
DATA AND THEMATIC MAP
DIGITAL CLASSIFICATION PROCESS
SOIL MAP
GEOLOGY MAP
SLOPE MAP
ELEVATION MAP
RAINFALL MAP
ADM. BOUND. MAP
OTHER MAP
LAND COVER
BIOMASS
DATA CONVERSION FROM A/C TO D/C (DIGITIZE)
DISPLAY
DIGITAL DATA REGRESSION
COORDINATE DATA (PIXEL)
DATA BASE (INITIAL DATA, FILE LABEL)
SELECTION METHOD AND DATA SELECT
DATA ANALYSIS
PREPARATION OF DATA SCORING
PATTERN METHOD
RANKING METHOD
STATISTICAL ANALYSIS
PRINCIPAL COMPONENT ANALYSIS (PCA)
TRANSFORMATION
DISPLAY
EDITING
STATISTICAL DATA
LEGEND
DISPLAY
PLOTTER
PRINT
REPORT

TABLE 9.7. RESULT OF LAND EVALUATION FOR JAVA, MADURA, AND BALI ISLANDS USING "PATTERN" METHOD (Km^2)

No.	Class		Areal	
			Km^2	Percentage
1	I	(TP1)	21,476.60	(15.84)
2	II	(TP2)	6,152.20	(4.53)
3	III	(TP3)	7,544.40	(5.56)
4	IV	(TP3')	20,680.00	(15.25)
5	V	(TC1)	9,640.00	(7.11)
6	VI	(TC2)	23,352.00	(17.22)
7	VII	(TC3)	9,680.00	(7.14)
8	VIII	(TK1)	18,732.00	(13.81)
9	IX	(TK2)	5,500.00	(4.05)
10	X	(TK3)	8,280.00	(6.10)
11	XI	(C)	2,354.51	(1.74)
12	Unclassified		2,177.00	(1.60)

Source: Data Analysis.

Notes:
TP: rice fields
TC: mixed crop
TK: perennial trees
C: cloud cover

In the scenario of estimation of rice fields in Java and Madura, as mentioned in the purpose of the project, in 1983 the area of rice fields was 4,779,000 ha, in 1988 it will be 5,100,000 ha. Comparing this with the statistical data from the processing of data base in Java and Madura the area was classified as TC-1, TC-2, and TC-3.

In the year 2000 the demand for land for nonagricultural uses will continue to increase and in the estimation of rice field area, it will expand to about 4,800,000 ha. The second case study draws a comparison between rural and urban land-use.

Urban Monitoring Case Study

The goal of this study was to evaluate land-use changes in metropolitan Jakarta and the surrounding area through multitemporal satellite data. In fact it is not monitoring as a part of a sequential stage in development activity, but an indication of land-use change in the area.

REMOTE SENSING SYSTEM AND DIGITAL PROCESSING

The target area is metropolitan Jakarta and its surrounding area, which administratively consists of a *Kabupaten* and five municipalities (*Kotamadya*) of Jakarta. In this study the area is mentioned as Cisadane-Jakarta-Cibeet (CJC), according to the names of the rivers which delineate the area.

Up to 1976 eighteen master plans concerned with land performance were carried out in the CJC area by various agencies, among others, the Jakarta master plan by the Provincial Office and the water resources master plan by the Ministry of Health.

The growth of the urban population in the CJC area is the main factor determining future water requirements. Water is used for irrigation in the rural areas and for drinking water, industry, and sewerage in the urban areas.

For the analysis and forecasting of water supply needs by the year 2000, the population and the irrigation area forecasts were taken into account. Table 9.8 describes the urban population growth prospects in the year 2000 in JABOTABEK with increasing 24 per cent population density per ha in Jakarta and 66 per cent in the urban area of BOTABEK.

User Interest and Participation in the Project

An examination of data available in the remote sensing project indicates that so far the data being generated for programme planning by various agencies is still sectorally-oriented.

There are several reasons why the information system is unable to make use of existing operational data for the integrated planning process. First, implementation of planning result is on a sectoral basis. Second, linkage between the remote sensing project and other agencies has not been properly established because most of the agencies have their own data processing units. Third, a regular reporting system of the remote sensing project has not been formulated because of the lack of financing for replicating the results.

LESSONS LEARNED FROM THE INFORMATION SYSTEM PROJECT

Organization and Management

The remote sensing project was established in 1980 within the Centre for Data Processing and Mapping in the Ministry of Public Works. Its spatial information system is currently the responsibility of the Secretariat General. In 1986, operations

TABLE 9.8. SELECTED URBAN POPULATION GROWTH PROSPECTS

			1971	1985			2000		
			Population (000)	Population (000)	Density (per ha)	Area (km^2)	Population (000)	Density (per ha)	Area (km^2)
JAKARTA	Urban population		4,576	8,262	133	620	10,227	165	620
BOTABEK	Rural population		1,930	1,640			1,287		
	Scattered urban population			1,293	30	432	3,541	50	708
	Population of growth poles		452	1,375	100	137.5	6,226	110	566
	Constituent Centres	Ciledug					348		32
		Ciputat					296		27
		Serpong					400		36
		Parung					359		33
		Depok		100		10	247		22
		Cibinong					131		12
		Gunung Putri					126		11
		Cilungsi					65		6
		Pondok Gede					335		31
		Bekasi		125		12.5	338		31
		Cimanggis					73		7
		Bogor		525		52.5	1,302		118
		Tangerang		425		42.5	1,281		117
		Cikarang		200		20	924		94
TOTAL JABOTABEK			6,958	12,570			21,280		

were transferred from the Secretariat General to the Directorate General for Research and Development.

The remote sensing project has been entrusted with the responsibility of preparing spatial information for the Directorate General (Operational Agency).

The link between the remote sensing project and the Directorate General is expected to provide access to spatial information regarding resource availability at an early stage.

Data Handling

The main function of spatial information is to store primary data, secondary data, and other special data through geo referencing. This should meet the following general requirements:

(1) It must be capable of satisfying the objective for which it has been designed.

(2) It must be practical to establish and operational.

(3) It must be compatible with existing systems and institutions in the country.

ANALYSIS

Performance of the Urban Information System

Performance output from the remote sensing project does not yet play a full role in the structure of an ideal information system for urban and regional planning, because it has only a display role in the physical structure and administrative boundaries.

In addition to specific information such as socioconomic data and distribution of population settlements, other data should be added to the regional data bank system, so that the planner and policymaker will achieve good results.

Factors which Inhibited the Achievement of Project Objectives

The factors which inhibited the achievement of project objectives can be summarized as follows: The design of an integrated regional data bank system invariably encounters problems of coding and standardization of data, and using geographic reference codes to convey information with relative location; the socioeconomic data is difficult to store in geographically referenced coding because socioeconomic data usually has no relation to spatial referencing.

Improvement of the Project

Improvement of the project should be considered from three aspects, viz., organization, development of technology (hardware system, software system, and technical know-how), and international cooperation.

Organizations must be developed and stabilized with good management, because besides the routine function of storing and supplying data for the operational agencies, they should play an active part in promoting the information system in such a way that the information will be accurate and convenient for planners and decision makers.

In the last decade, development of technology has proceeded rapidly -- which means that hardware and software systems will repeatedly change with more and more modern equipment. The problem is thus how to anticipate new situations, especially in the training of personnel. Technical assistance is still needed for development of the remote sensing project.

Provision of remotely sensed satellite data which is used as baseline data for the spatial information system requires international cooperation because many new satellites are already planned to be launched in the period up to 2000. Problems will arise if this system of new satellites is not compatible with the processing units.

CONCLUSION

The spatial information system is based upon computer equipment which is very powerful for data handling and storage. An integrated system requires the interaction of remote sensing techniques, computer systems, planners, and decision makers.

Technical aid from developed countries in terms of equipment, experts, and training is still needed for promoting the spatial information system. Transfer of technology based on a total package system and learning-by-doing from the experts is an effective way. The spatial information system is not yet in optimal use for urban and regional planning in Indonesia. Local governments generally still use manual processing for data handling and presentation.

NOTES

1/ Ministry of Public Works, *National Development in Indonesia* (Jakarta, 1982).

2/ Jan P. Van Est et al., "Information System for Urban and Regional Planning" (Paper presented at the Regional Seminar on Information Systems for Subnational Development Planning, Visakhapatnam, 1985).

3/ Teken, "Utilization of Tidal Swamp Areas: An Expensive Necessity" (Paper presented at the Symposium on Lowland Development, Jakarta, 1986).

4/ Sumitro Djojohadikusumo, *Indonesia towards the Year 2000* (Jakarta, 1974).

5/ Teken, "Utilization of Tidal Swamp Areas."

6/ Haedar Ali Tubagus et al., *Land Resources Evaluation for Agricultural Development in Indonesia* (Jakarta, 1974).

7/ Van Est et al., "Information System for Urban and Regional Planning."

8/ Ibid.

10

EVALUATING THE STATE OF INFORMATION SYSTEMS IN AMSTERDAM

Frank le Clercq

INTRODUCTION

This paper is about information systems (ISs) in use at the Physical Planning Department of the City of Amsterdam in the Netherlands. Since Amsterdam has a long planning history, which dates from the time before automatic equipment was used to process information, the present ISs are a result of the successive introduction of new techniques and new data, and hence are not integrated into one comprehensive system. ISs in use at the moment in Amsterdam include: (a) a population forecasting system; (b) a transportation planning support system; (c) a land-use (particularly buildings) registration system; (d) an employment forecasting system; and (e) several *ad hoc* systems to register and forecast the use of population facilities (sporting facilities, schools, parks, etc.).

This paper deals with the first three systems, because each is an illustration of what an IS might provide in support of planning and how systems evolve in time. The present characteristics of the systems are summarized in appendices 1-3.

The paper itself starts by describing the context of the systems' use as well as the way in which they have developed. This beginning allows us to draw some general conclusions in the next section about ISs in an evolving planning environment.

The third section elaborates on the experience with the systems in Amsterdam, but this time from an outsider's perspective: assuming that an integrated approach to planning support ought to be recommended, what then can be concluded?

The considerations draw heavily on theoretical work performed at Northwestern University. Therefore the final conclusions are more general and do not solely reflect, we think, the

Amsterdam case.

THREE PLANNING INFORMATION SYSTEMS IN AMSTERDAM

Three systems that deal respectively with population, transportation, and use of the buildings are considered with respect to their history, their present purpose, and their method of functioning. These three particular examples have been chosen because each expresses a facet of information in urban planning:

- the population system serves as the basis for multisectoral facilities planning and programming, thus a heavy emphasis is placed on the accountability of population forecasts.
- the transportation system has evolved from a traffic counting system to an advanced planning support system for transport infrastructure decisions. It applies sophisticated modeling techniques.
- the building-use system is important because it relies very much on geographical reference data; such data in turn is seen as a uniform reference to integrate (physical) planning information sources and map-dependent applications.

The Population Forecasting System

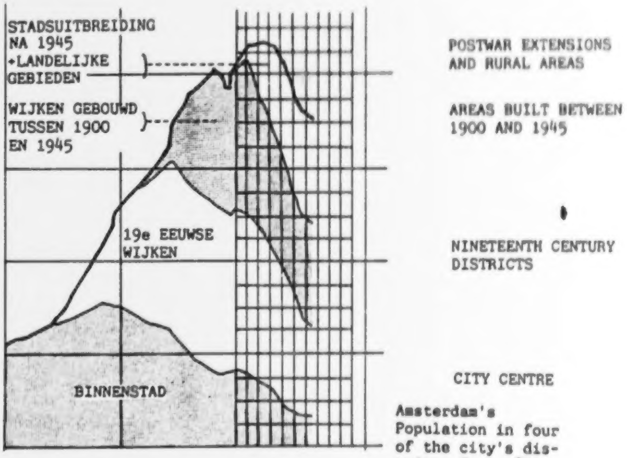
It has been the practice for more than a century that everybody in the Netherlands is obliged by law to register personal antecedents at the municipal administration, such as date of birth, gender, marriage, children, and current address. Data were controlled and updated every ten years by means of a population survey. This survey, though, was used more and more as a general population inquiry, and hence, caused considerable opposition resulting in the decision to postpone the 1980 population count to the future, which is still the case.

Population information has always been very important for planning, as the history of Amsterdam's expansion can be viewed as a series of efforts to accommodate an increasing population. At the beginning, say till the turn of the century, this occurred in a market-dependent way, i.e., it was believed that rooms could be found for the growing population, and that population growth could serve the city's economy. Later, when social concerns were also considered important, population growth was managed with respect to the quality of housing, public health, and the like. Since 1935, Amsterdam's expansion has been moulded according to modern town planning principles. These imply that, along with the ideas regarding individual standards of living, the spatial shape of the city is of concern for public policymaking.

A number of municipal departments, therefore, rely on population figures (forecasts) to set their programmes: the education, recreation, housing, social securities, and budget departments. Every two years an official forecast is jointly published by the city's statistical department and the planning department.

The nature of and the necessary background information for the forecasts can be learned best by an example of Amsterdam's population developments. After 1962, the municipal population had declined, although the housing stock was still increasing. The pattern is illustrated in figure 39.

Figure 39. Population Development in Successive City Extensions



Amsterdam's Population in four of the city's districts from 1850 onward

The figure also shows that similar patterns of population decline have been observed for the various neighbourhoods of the city. The decline usually begins some years after no vacant space is left to build new houses. So population developments in a spatially restricted area are the result of the combined effects of: the supply of houses, family life cycle, migration, and family size.

In this respect a general population wave for a typical neighbourhood can be described as follows: A supply of houses, due to new construction, renovation, or vacancy, attracts young families which start to grow and move to other neighbourhoods with better housing or more open space, or which stay and see their children leave.

The forecasting system copes with these factors by starting at known plans for housing supply, combining this information with typical patterns of population cohort developments in the various districts and accounting for citywide migration patterns and nationwide demographic (death and birth) trends. The results are neighbourhood population forecasts per cohort and citywide aggregates of these figures. Housing demand and the resulting need for city expansion follow from tensions between the accounted supply and registered cohort developments per neighbourhood on one hand and city and nationwide demographic developments on the other. This gives rise to alternative scenarios in planning and the inclusion in the official biannual forecasts of an aggregate margin.

Hence, input comes from the municipal population registration system, existing and planned housing stock, and nationwide demographic trends.

Output concerns neighbourhood population forecasts (for facilities and service planning purposes) and citywide forecasts (for strategic planning purposes, such as housing and city expansion/regional population distribution).

Information is provided through: collection of information about planned and expected neighbourhood developments; analysis of the yearly data on demographic trends supplied by the population registration department; gathering of information from various sources about dwelling occupancy developments (family-size compared to quality of housing); and inclusion of regional and national migration and demographic trends.

A considerable amount of expert knowledge is required to deal with the input. This holds true for information on neighbourhood developments and housing occupancy. This information should be subjected to interpretation before it can be brought together in a population forecasting model that computes the neighbourhood/cohort forecasts on the city's mainframe (IBM) computer. The results represent the experts' opinions about likely population developments in Amsterdam. However, these are accepted by other concerned departments, because the figures are adjusted once every two years to take new evidence into account.

The IS as such could be characterized as an expert's calculating system. It is not accessible to nonexperts. Thus, the only way to acquire (alternative) management and planning information is by addressing the experts.

Transportation Information

The history of the present transportation information system in Amsterdam dates from the traffic boom period, which was characterized by an expanding city, a spatial overflow of population to suburban and rural areas, and rapidly increasing car ownership. Around 1960 both the systematic collection of traffic data and the compilation of trip data from travel surveys began.

Traffic data were acquired to keep track of the increasing traffic problems, or, alternatively formulated, to underpin the need to expand the highway system. Trip data were needed to gain an insight into the causes of traffic flow, because it was clear that a rapidly changing city would induce a shift in trip patterns that could not be forecasted by simple extrapolation of traffic volumes.

Throughout the sixties, efforts with respect to transportation information have included: (a) the development of an understanding of transportation phenomena; and (b) the establishment of the need for new transport facilities, including a complete metropolitan light rail system. Ironically, the latter effort has preceded the former. Decisions with respect to system expansion were based more on feelings regarding overcrowded roads and on common opinions about city and transport system expansion rather than on scientific traffic forecasts. The latter was important only on the project (i.e., resource allocation) level.

During the 1970s, the changing emphasis on growth control, as well as the problems with increasing public transport deficits and the oil crisis, made it possible to profit from the knowledge acquired about the transportation phenomena. Strategic insights could be gained about the causes and, as a consequence, the remedies for managing traffic growth and transit patronage. This was completely in line with developments in the transportation profession elsewhere.

This period marked the beginning of the transportation IS in its present form. The IS began as an effort to build an integral and comprehensive transportation model, it then moved into the second phase with the introduction of a systematic and continuous sample survey of households to investigate travel behaviour, and finally it reached the last phase with the integration of model results with the real traffic counts.

EVALUATING THE STATE OF INFORMATION SYSTEMS

At present a redevelopment process is beginning. The process is aimed at facilitating the application of information supply tools on a microcomputer in order to allow people working on specific projects to apply their own methods, congruent with overall transportation forecasts.

The present situation will be explained, first with respect to the system's purposes, and second with regard to its organization.

Today's requirements are manifested at two levels. Changes in transportation patterns will occur largely due to spatial shifts and not due to changes in personal mobility. For instance, shifts of employment to the urban fringe which has a relatively poor transit system, but good access to highways might affect transportation patterns more than further increases in car ownership would. This can be seen as strategic shifts which the information system should take into account, for reasons of project selection for instance. Spatial shifts in land-use and changes in major transportation systems are the most important factors to be considered.

A second set of requirements regarding information provision stems from project applications. This concerns the forecast of (transportation) impacts of new transport facilities or operations. In this connection, the geographic scale of the impacts as well as the input requirements on land-use data might be limited. It is therefore necessary to consider the system characteristics.

A third set of requirements for the IS concerns its flexibility to adopt new knowledge. The modeling system allows the introduction of new variables and even new structures, without destroying the entire system. This work can only be performed by the system developer and not by the users.

The structure and organization of the IS can be explained by describing some intermediate output requirements. An appropriate transportation information system must be able to: provide assigned networks for the various travel modes, based on origin-destination trip-volumes; create origin-destination tables for present and future situations. The latter can be obtained from travel demand models which are a function of demand explaining factors, and which provide demand elasticities.

This system provides a supply of basic information about present-day and (strategic) future network use and the underlying trip patterns. It also allows the individual user to vary marginally with respect to the data for project application, because of the elasticities.

Necessary input includes land-use and network data. Traffic counts are integrated into the basic data by adjusting the o-d matrices for the base year period to volumes counted on cross-sections; this brings the network forecasts in line with available traffic counts. This latter application of traffic data (i.e., to adjust trip tables) will eventually allow the importation of a model from elsewhere, without performing model estimates on trip data from the Amsterdam region. This option, however, has not yet been used; it still proves that information gained directly from household interviews provides explanatory insights that cannot be obtained from the modeling-based information system. This is concerned especially with elasticities.

Compared to the previously described population forecasting system, the transportation information system is decision-oriented. It suffers, however, from its own completeness in the sense that it is too complicated for an untrained user to apply, although the computer programme system is structurally very well designed.

Recent efforts to install the system on a microcomputer, as far as project applications are concerned, will improve end-user applications, however. System designs allow this development, and planning applications will need it.

Building-Use Information

Building-use information contains very relevant data for planning applications. This type of data has a strong relationship with geographical reference systems or geocoding systems. The introduction of the latter is a recent development in Amsterdam.

Traditionally, town planning was concerned mainly with city extensions. Literally, the only relevant data for an extension area were those on the proposed land-use, because the existing land-use was either very homogeneous (agricultural) or of a low economic value. So the plan and plan map were the proper data sources for decision making and plan implementation.

The growing awareness of the need for urban renewal and the need for planning regulation in already built-up areas changed this planning and data perspective. Knowledge of the use of the existing city became a requisite for planning. In Amsterdam this was very obvious for the ancient and prewar areas. These areas already existed when the general extension plan was proposed in 1935.

EVALUATING THE STATE OF INFORMATION SYSTEMS

The need for data on the use of the existing city is met by conducting surveys to inventory the number of rooms in tenants' dwellings and the functional use of houses other than residential. The results of these surveys are included in the building block maps which show the layout of blocks of houses and roads.

The data is inputted into a computer programme. This allows the calculation of the average floor occupancy, aggregate surface of floor in use for various functions, etc. These types of figures are very informative on a longitudinal basis, because they give an impression of how functions alter and move through the city. The data collection process, though, is very labour intensive, for each dwelling must be visited. Only selective building blocks, therefore, are surveyed for planning purposes. In practice, a unit is visited every seven years.

The information gathered has proved to be very useful for urban renewal purposes, especially when the process centres on rehabilitation and on individual ownership rights. Strategic information includes the distribution of family types over housing types. This information is quite useful for population forecasts.

Other municipal agencies have similar types of inventory systems: the housing redistribution department for purposes of allocating families to appropriate vacant rentals; the housing construction department to keep track of the stock of government-owned dwelling units in the city (up to 60 per cent); the tax revenue department to value real estate for property and building-use tax purposes; and the land registry department for purposes of ownership registration. These departments face similar technical problems, e.g., how to geocode the information (for purposes of aggregate statistical information) and how to maintain inventory quality in times of budget cuts. Since some parts of the inventory systems overlap, it was recently decided that all the systems should be combined into one inventory system from which the various users can tap their particular data.

Parallel to this initiative for cooperation, another initiative aims to geocode all infrastructure and buildings in Amsterdam for purposes of preparing digitized computer maps. If combined, these initiatives will provide functional and mapping information for generating alternative plan designs (computer-aided design).

These geocoding and mapping developments are rather new in Amsterdam. They are heavily "supply driven" in the sense that the new technical opportunities are the driving forces behind the search for new approaches. Combined with the need to cut budgets these developments might result in a replacement of manpower by computers. They will also open new perspectives for the design phase of urban planning: real-time information about an existing situation will reinforce bottom-up approaches rather than schematic designs.

Summary

Three of the information systems of the Physical Planning Department have been examined: the population forecasting system, the transportation planning information system, and the building-use information system. They serve as examples of the various types of information systems that might support urban (and regional) planning. The population forecasting system provides an integrated basis for multisectoral planning purposes. The transportation planning information system is an example of planning support systems in which planning variables can be used to simulate alternative planning proposals. These systems can be effective tools in planning sectors where government has a great degree of control, as in decisions to build roads. The building-use information system is an example of planning data systems. New technology opens new opportunities to bring these data sources together and create a basis for new (computer-aided) design approaches.

EVOLVING PLANNING INFORMATION SYSTEMS

The information systems in Amsterdam followed the same development pattern for all information systems:

- an initial need to acquire data in order to learn more about a new planning issue. The data is either acquired from existing sources (e.g., existing population registration systems) or gathered on an *ad hoc* basis.

- information acquisition is improved and often expanded as knowledge increases about a phenomenon.

- at a certain stage technical elements of the information systems seem to overshadow or even divert attention from the planning purposes, resulting in actions to reorganize or abandon the systems.

- the process of discussing the value of existing information systems is stressed on the one hand by the need to cut budgets and on the other hand by the supply of new technical opportunities. Both causes, though, can be counteractive to each other, depending on the real need to continue the existence of the information system.

EVALUATING THE STATE OF INFORMATION SYSTEMS

This section will deal with information management concentrating on the Amsterdam experience. The next section will then formulate a general approach to the analysis of information requirements in planning agencies.

This section describes the cyclical process of the "natural" development of information systems, beginning with an interest for data on to knowledge bases and applications. This is called the cognitive information acquisition process, which explains how data is transferred into knowledge and subsequently into applications:

- Confronted with a problem, one starts to gather data on the basis of some initial ideas regarding the structure of the problem;
- This data is essentially used to sharpen the idea, (mental) model, or schema of the situation at hand;
- The validity of the improved (mental) model is proven once it is applied to solve the problem;
- If the model is not valid, the process is repeated.

This continuous cycle may be applied as a model for evolving information systems that deal with successive problems (instead of repeated trials to one problem). Conditions for the continuation of the cycle include continued demand for information, adequate speed of information provision, and positive costs/benefits.

This idea of an information processing cycle has served as a basis for selecting the elements for evaluating the three systems under study.

Data and Knowledge Bases

Data and knowledge may be complementary to each other in providing information. This is clearly shown by the transportation information system, where models have been used to partly replace network counts and collect data on origin-destination trip-volumes. Data which could not be measured at all have been obtained, e.g., demand elasticities.

Figure 40 illustrates this idea of data and knowledge complementarity. It also indicates the range of associated information systems, from a simple (statistical) data system to a sophisticated modeling system.

Figure 40. Substitution of Data and Knowledge

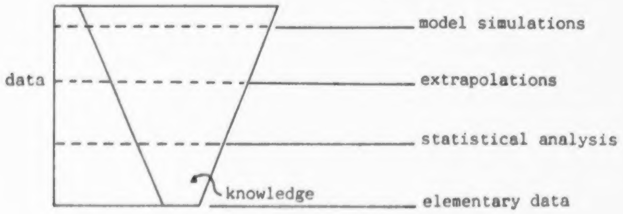


Figure 40 does not simply show the complementarity of data and knowledge, but acknowledges that the more advanced systems are usually able to generate more information. This illustrates trade-offs that are inherent to the elements of information systems. A number of these trade-offs will be exemplified:

Measuring versus predicting

Prediction of facts, as opposed to measurement, involves the structure of the phenomenon under consideration. The three systems clearly indicate this.

- The building-use information system (and in line with this the current geocoding and mapping systems) is completely data-oriented; only factual information is obtained from measurements at the site.
- The population forecasting system relies very much on knowledge, but only for extrapolating base year population measurements and not for creating more generic information. The system is therefore still very much data dependent, e.g., it requires base year data which are as precise as the forecast should be, and the knowledge is hardly transferable.
- The transportation information system is a completely knowledge (models) dependent system in the sense that without models, the collected data would hardly be sufficient to create a picture of the situation at hand.

Measurements are a safe basis for information, but the information provided can hardly be abstracted into more general insights that will allow one to deal with very rapidly changing circumstances. On the other hand, knowledge-based systems (models or sophisticated analysis techniques) are, by their very nature, able to predict. These systems may be very complicated, difficult to apply, and often serve as sources of too much information (overkill).

A choice between either methods of acquiring information is often dictated by one's ability to oversee the problem area: if one has no knowledge about the situation, then a knowledge-based system will not suffice to throw light on the problems. In that case only site measurements may bring some clearness.

Low-skilled versus high-skilled work

Developments in information systems in Amsterdam have shown that a shift of emphasis from data collection to information production by more advanced methods results in a shift from lower-skilled data inventory activities to higher-skilled work involving the development and application of computer software. Only data input is common to both activities.

Within the group of higher-skilled employees, it was very difficult to encourage interest in lesser activities than the outcomes of computer runs. There seems to be a value-ranking of activities ranging from mere data collection, via "running" and developing computer software, to interpreting the outcomes in the light of the planning process. Application knowledge is more highly valued than phenomenological knowledge in the Amsterdam planning agency, which requires increased capability for computer use.

With regard to the question of whether to strive for either a data- or a model-based information system, the following points are important:

- Knowledge (model)-based systems will require higher-skilled people than data-based systems;

- Application knowledge seems to set the norm for the use of knowledge-based (e.g., modeling) systems in a planning agency. This implies a need for imported information systems which are end-user and application-oriented, rather than hiring people to create in-house tailored information systems;

- Planning management must know about the application specifications of the information systems to direct their proper use and to know when to change gears. A staff-person or group providing support to management could be very useful.

Sources and resources

Experience in Amsterdam has shown that, in times of budget cuts, it is very difficult to maintain data sources which are created solely for the purpose of planning applications. For instance, one of the strongest motives for maintaining a building-use information system is its value for tax applications. Thus, the use of other data sources (e.g., existing registrations) should be explored.

The resources available for information systems should be used instead for investments in the (knowledge) system itself rather than for maintaining a flow of input data.

Type and amount of information

As figure 40 suggests, one of the elements that might affect the choice of a particular type of information system is the amount of information. The less information that is required, the simpler the system can be (e.g., simple data extrapolation to make forecasts in an only slightly changing situation). In retrospect, this seems true because knowledge-based systems produce much more information than required about a particular situation -- resulting in an information overkill -- which makes the effectiveness questionable.

It is necessary for information systems to be more selective in the provision of information for the planning process. Either the system managers or the system itself should know which planning information to provide. Nevertheless, there is a trade-off: the less specific the planning requirements are about the type of information, the greater the amount of information created and provided by information systems managers. They do this to avoid complaints about lack of information, but this often results in complaints about information overload.

In view of the capacity to provide the necessary data, information management from the perspective of information use is becoming more important than management from the perspective of supplying as much information as possible.

Evolving Application Areas

Planning applications have also evolved in Amsterdam and affected the information systems as exemplified by the information processing model. The more experience one has with applications, the better tailored the information systems can be. Together with this internal learning effect, there have been shifts in applications requiring adaptations to external developments.

The external (application) effects involve changes in the planning environment and improvements in knowledge and explanation of urban phenomena (mainly due to academic research, resulting in new methods, procedures and approaches).

Changing planning conditions

In the past thirty years, physical planning in Amsterdam has changed from extension to maintenance planning and then to the current action-oriented approach. The latter approach could be called a management approach to planning. Extension planning involved expanding the city and building completely new infrastructure and facility systems. The maintenance approach involved maintenance of nearly completed urban infrastructure and facilities, with special attention to their distribution and nuisance effects.

Management approaches to planning recognize the dynamics of cities and the need for a continuous adaptation to new developments (e.g., gentrification and a shift in the economy towards information dependent industries), in accordance with the strategic goals of strengthening the city and enabling the population to profit from the resulting improvements (i.e., establishing linkages as a planning instrument).

The evolution of information systems has been spurred by the following:

(a) The need for long-term forecasts about alternative futures (scenario approaches), in order to select strategic goals and instruments for development. For instance, the population forecasting system in Amsterdam should be able to indicate interregional migration and people's preferences for residential areas on an aggregate level.

(b) The need for precise information about the existing situation to serve as a basis for more detailed regulation and planning control. Among the constraints are the (political) fear of over-regulation and control, the excessive cost of data collection compared to its eventual use, and the inflexibility of large data systems. The new information technology offers new opportunities for information systems to survive.

(c) The need for information systems to respond to required changes. Within the built-up environment changes in response to demands may have unexpected effects. For instance, the rise of new industries on the urban fringes (at the expense of downtown developments) is an unexpected side effect of the creation of an interregional highway system.

(d) The need for information systems to support project studies (e.g., transportation planning information systems).

(e) The need to include qualitative knowledge about new developments.

New planning methods

The issue then is whether new planning methods are an answer to new planning needs, or the other way around, i.e., new planning needs could become manifest due to new methods. The fact, however, is that methods to support planning applications have been developed considerably. The best example in this regard can be found in the transportation field. Responsive travel analysis methods became available when transportation planning moved from system expansion to operations and project evaluation studies.

In Amsterdam this caused, in the mid-1970s, a complete reorganization of the transportation information system. One of the objectives was to bring the in-house expertise to the same level as that of the consultants hired by the national government for conducting studies in the Amsterdam region. So an element of knowledge competition had been added to maintain a negotiating position.

In general, it is important to avoid situations where new methods can create a supply push on the development of information systems. Ideally, the decision situation at stake should dictate information requirements. Realistically, this will be very difficult. Apart from the need to negotiate, it will be difficult to assess new developments. As a result, the fashion in the profession can become the leading guide.

Summary: Managerial Considerations

Information systems are constantly evolving because of both internal and external forces:

- Increased knowledge of a phenomenon, due to repeated applications of the system, will cause a move from data-based systems to knowledge-based systems.

- Application areas are also constantly shifting. A mature planning system tends to control developments rather than guide external opportunities for development. This implies an emphasis on predictions of what can happen through controlled action.

- More highly-skilled personnel working on improved systems will bring the information systems above the levels required by their applications, resulting in a demand for more selective information.

- Resources for planning information can be very problem dependent. In this respect, it is better to invest in information systems knowledge than in the maintenance of a continuous data flow.

- Scientific knowledge about urban and regional phenomena is improving. Most planning information systems reflect these knowledge developments, on account of the upgraded skills of internal experts and the incorporation of new methods and models.

Information management recognizes these evolutionary trends, and examines their importance in supporting planning and decision making.

- An information system should include new information;

- Planners must be able to apply the information systems and their output. This will result in internal equilibrium in the organization regarding information systems features. Training of the end-users of the system (i.e., planners) will be needed to reach this goal;

- An information system follows various routes in the information process, from initial problem to final decision. It should not be restricted to the problem-alternatives-evaluation-decision sequence; and

- An information system must be able to present management or aggregate information reflecting the state of applications with regard to decisions taken and options that are still open for study. The information system should allow management to broadly test new options for decisions.

The last two points not only deal with the management of information, but also indicate the requirements to facilitate the management of planning processes.

EVALUATING THE STATE OF INFORMATION SYSTEMS

A PERSPECTIVE ON PLANNING SUPPORT SYSTEMS

This section aims to assess information requirements from a user's perspective, particularly the perspective of decision makers and those in charge of planning processes, such as managers of planning agencies.

The approach described here relates to decision support systems (DSS).1/ A DSS consists of three components: a data base; a model base; and a man-machine interface.

The data base contains all the factual information available. The models are either applied to simulate decision alternatives or to design optimal solutions. Thus, a DSS combines most of the information sources that are already in use in planning, but from a decision making perspective.

The third component of a DSS particularly emphasizes the decision makers' perspective. The man-machine interface has a number of cognitive aspects, ranging from ease of input and proper and imaginative presentation of output, to defining appropriate software structures that really reflect and support human working processes. Manheim calls such systems, symbiotic decision support systems.2/

This section will concentrate on the man-machine interface and in particular on the problem-working processes, which are principally restricted to urban planning.

Planning Support Systems Extended

Design processes and evaluation approaches in planning show that the substantive products of a planning process (e.g., a plan for a city's extension or policy formulation) can be described by the attributes, elements, or variables which compose the products.

Design brings together a set of elements or attributes into feasible or optimal combinations (with respect to certain goals). For instance, the design for a city's extension may be developed by combining the physical elements (roads, parks, buildings, etc.), and taking into account their supposed use. Multicriteria types of evaluation studies3/ (i.e., studies to determine the "best" out of a set of alternative solutions to a problem) often present alternatives in the form of an evaluation matrix (a table in which solutions are cross-referenced with decision-process attributes). For instance, alternative designs for a city's extension plan may be represented by the cost of each plan, the number of houses to be built, and the environmental impacts.

The planning products, as well as the expert systems, can be described in a solution-attribute matrix.4/ An expert system consists of a set of alternative outcomes onto which a problem must be mapped (classified) according to the information characteristics of the problem. For instance, to diagnose an illness with an expert system one interviews or examines a patient and tests how this information fits into a set of preassumed illnesses (available within the expert data base).

Thus, we may represent the basic information process as the handling of a two-dimensional matrix of solutions and attributes, on which three basic operations might be performed: creation of new solutions (design process); assigning values to attributes (simulation process); and extending the set of attributes (knowledge acquisition).

Conventional decision support systems are able to perform the second step (and sometimes the first step as well, when an optimization programme is applied), leaving it to the user to determine the solutions for simulation. The third step, the addition of new attributes, or the acquisition of new knowledge about the solution domain, is also a matter external to the decision support system. In an analytic approach it may go through several formal steps, such as data acquisition, hypothesis formulation, and analysis.

Elementary tools for planning support which result from this approach, are presented in figure 41.

Figure 41. Information Acquisition Matrix and Elementary Planning Support Tools

		knowledge about problem- and decision-attributes	
		known	to acquire
solutions	to be selected	simulation, (by DSS)	analysis support
	to be designed	design support/DSS	analysis support

The matrix shows the knowledge one has about the attributes, which ranges from knowing what to apply to select or design a solution, to acquiring data to find the attributes. The matrix also shows the tasks to be performed in the planning process, including selecting from a given set of solutions or designing new solutions.

The existing support tools are primarily DSS-type systems and (statistical) analysis systems. New developments concern computer-aided design tools.

Two discrete stages of knowledge are involved: analytically knowing about attributes or acquiring new attributes. The situation for solution is similar. Solutions are supposed to be known or designed.

Reality, however, is not so discretely divided. Planning people may know what to do, even though no models are available and no analysis is done. Their knowledge includes, for instance, policies being considered by a city -- which may address new problems without precise information about attributes. Solutions may be restricted by conditions, thus resulting in a choice between predetermined solutions and designing new solutions.

Very often this kind of nonformal information is dominant in decision processes and hence excludes the use of information systems. To know about such information and to include it in information systems will tie the systems to the reality of working processes.

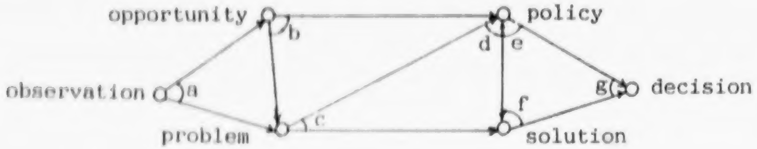
In brief, analytical information systems may or may not be applied to simulate or design solutions to a whole range of problems. Other knowledge and information may be available in the planning process and in the planners' minds that show how to select and value the attributes and how to restrict the solution-space. This is called heuristic knowledge.

Problem-Working Behaviour

A research project was undertaken on urban planning cases with respect to: stages in the development of a policy or decision on urban development; and the approaches applied by planning management in the development of a policy or decision. The fundamental stages that were found to be important are presented in figure 42, which shows the possible linkages between the stages and the choices between different courses of action.

The linkages may be executed either through standard operating procedures, planning approaches (e.g., design and evaluation), or more heuristic approaches. The heuristic approaches support a number of choices between different courses of action.

Figure 42. Network of Problem-Working Stages and Choices



Given the observation, the choice is whether to start problem-working:

(a) Does the observation include an opportunity for development or a problem to be worked on (e.g., a crisis problem)?

(b) How does one deal with an opportunity? Does one take advantage of the opportunity and decide accordingly (probably on the basis of a policy) or start a problem-working process to explore the opportunity for alternatives?

(c) What is the aim of the problem-working process -- policy formulation or decision making?

(d) Is it necessary for the policy formulation process to formulate solutions or designs, or is a general exploration of problems sufficient?

(e) Is it the purpose of a policy to support specific decisions (as the one about taking an opportunity) or to create a frame of reference for (future) problem-working?

(f) What is the nature of the problem-working process -- to design or compare solutions which are imported from elsewhere?

(g) The process control questions include: when to stop problem-working (control rule), and when and how to involve interested parties.

A study of the choices that are not currently supported by DSS might provide lessons about the additional information that must be supplied to management and about the less analytical knowledge that must be included in information systems.

Selection of choices will involve a consideration of the constraints to the solution space and the other knowledge elements involved.

The choices relate to: How to interpret an observation; What to do with an opportunity; Policy-related choices; and The process control question of whether to continue the problem-working process.

The information that support these choices can be determined by means of the heuristic approaches. Information issues include: the actual policies, strengths, and weaknesses of the city; plans on the shelf; recent solutions that were accepted or rejected; related problems; developments in the decision environment; and relevant external developments concerning the problem content.

A consideration of the problem-working process in an evolving planning context shows a continuous interaction between work on a specific problem and on a broader set of topics. This involves both policy questions (e.g., Is the project on target?) and information about similar experiences. The management's task is to stimulate this interaction process and derive new policy proposals, devise shortcuts in problem-working on specific projects, terminate projects which are not fruitful, and open new areas of study (observation). Such information will support management and help information systems managers (of the traditional information systems) to be more specific about which type of information to provide to specific projects.

In summary, the management of planning processes has to face many choices during problem-working. These choices are identified with respect to the critical stages of a problem.

It is necessary to choose the right information and to determine to what extent this information could be provided by present analytical information systems such as the decision support systems and data analysis systems. Choices which cannot be met, give rise to a shopping list of new data requirements.

Such information may already exist in most managers' minds, especially the more central information about policies and the quality of the urban system. Creating a new information tool may enable existing information systems to perform better.

Improved Planning Support Systems

The information requirements with respect to project-oriented applications have the following characteristics:

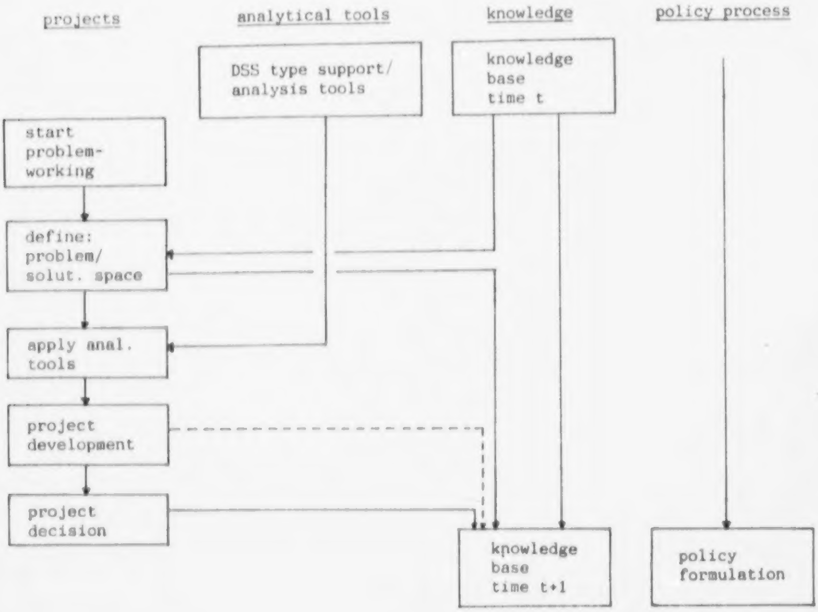
(1) An overall reference to any project application, including the policies and features of other related projects.

(2) Subjective knowledge (situation dependent), as opposed to more analytical knowledge in decision support systems, which applies the general knowledge to specific problems.

The information requirements in the policy formulation process include the following characteristics: The acquired knowledge will allow users to formulate policies in a bottom-up fashion (see the choice network in figure 42). Most of the policy items result from questions about observations and types of problems and are part of the knowledge system.

The flowchart in figure 43 delineates the characteristics of the management knowledge system.

Figure 43. The Position of a Management Knowledge Base


projects
analytical tools
knowledge
policy process
DSS type support/ analysis tools
knowledge base time t
start problem-working
define: problem/ solut. space
apply anal. tools
project development
project decision
knowledge base time t+1
policy formulation

There are four types of information flows:

(a) *ad hoc* work-processes to perform projects;

(b) use of any analytical information system, e.g., a DSS;

(c) use of the subjective dependent knowledge system and the adoption of new knowledge resulting from the work-processes; and

(d) a policy formulation process, which can either be an *ad hoc* process or a continuous process depending on the extent to which new insights must be confirmed by policy statements.

The management knowledge system is dynamic; it evolves from the problem-working processes. This origin from specific, ongoing projects will make it possible to develop the knowledge base step-by-step. The knowledge base can, therefore, be developed in each planning environment. The importance of the knowledge base will be proven in subsequent project applications, as it will facilitate appropriate management choices. Also, the application of analysis tools can become more specific, as, in the long run, the tools can be adjusted to applications that have proven to be important.

The concept of the management knowledge system needs further specification. Information items must be more specific and more detailed. Software functions should be added to allow the knowledge system to be more than a data base. Manheim has identified a number of relevant software functions, such as for the analysis of work-processes, the creation of a knowledge schema, and system architecture.5/

The issue is, what knowledge can the three information systems in Amsterdam supply to this management knowledge system, and how can they profit from it?

The population forecasting system contains overall (population) information that can be included in the knowledge system. Information on plans or programmes for urban facilities, as well as information on neighbourhood plans should be added to the system.

The selection of relevant functions for the end-users of the transportation information system could be facilitated by an analysis of past applications. For this purpose the information system must be augmented by information from planned or completed projects. The information system should include both travel demand data and other decision information.

The building-use information system and the future geocoding systems are only registration systems. The inclusion, however, in the geocoding system of all the policies and changes (plans) which are proposed for the built-up city could turn this system into an actual framework for the knowledge base in the management knowledge system.

CONCLUSION

The paper has reviewed three planning-sector information systems in use at the Amsterdam Planning Department: a system to make population forecasts; a system to supply information for transportation planning purposes; and a registration system for building-use, which might evolve into a geocoding system.

Each of the systems contains the type of information that needs to be provided in planning: population forecasts as a basis for sectoral programming of urban facilities; transport demand information that can be simulated to represent various planning options; and elementary data about the structure and use of the built-up city.

An assessment of the way the systems have evolved provides lessons on various aspects of information management. The choice of whether to have an observation (data) oriented information system or a model (knowledge) oriented information system can only be partially controlled. The information systems tend to shift from data to knowledge with increased knowledge of the situation to be planned for. The management determinants, though, are:

- The level of personnel working with the systems: the more knowledge-oriented the systems are, the higher-skilled the professional staff should be;
- The higher-skilled staff might "overkill" the systems relative to the end-users. A continuous and active end-user involvement in information systems specifications is recommended to reach a manageable equilibrium.
- New technologies such as microcomputers will support end-user involvement.
- Information systems that rely on data that are collected solely for planning purposes, might depend heavily on budgetary resources and on the management's interest in the planning results. For this reason, information systems should rely mainly on data that are also collected

for administrative purposes, and invest in knowledge-oriented systems.

- Knowledge-oriented systems may suffer from an information overkill. This effect is strengthened if the information requirements are not well-specified. The management itself should take action to enforce user requirements. This can be done by formulating requirements for information systems.

Information requirement analyses were addressed in the paper by describing some theoretical work undertaken by the author. The requirements for information systems include the creation of analytical systems (e.g., decision support systems and statistical analysis tools) and of a management knowledge system that contains all the dynamic knowledge about the evolving planning context. The three information systems in Amsterdam could supply management knowledge and gain from this knowledge.

NOTES

1/ Peter G. W. Keen and Michael S. Scott-Morton, *Decision Support Systems: An Organizational Perspective* (Reading, MA: Addison-Wesley, 1978).

2/ Marvin L. Manheim, "Creativity Support Systems for Planning, Design, and Decision Support," *Microcomputers in Civil Engineering* 1 (July 1986).

3/ Peter Nijkamp and Jaap Spronk, eds., *Multiple Criteria Analysis: Operational Methods* (Hampshire: Gower, 1981).

4/ Fry (1986).

5/ Marvin L. Manheim, "The Third Computer Revolution: Implications for Training in Developing Countries," *Regional Development Dialogue* 8 (Spring 1987).

APPENDIX 1. THE POPULATION FORECASTING SYSTEM

Funding: System development is financed by the Municipality of Amsterdam, which also operates the system.

System description: The system consists of a set of software programmes that: subtract data from the population registration system; analyse these data for demographic characteristics; and present forecasts on the population life cycle of a cohort and a neighbourhood on the basis of demographic, migration, and housing supply data.

Hardware and software: The system runs on a IBM mainframe computer. Analysis software includes standard software packages (e.g., SPSS).

Planning data base: See system description.

Services by the system: Biannual publication about population developments and population per district in Amsterdam, to be used as reference by sectoral facility programming agencies; supply of data (e.g., urban renewal) for neighbourhood plan groups; and expert consultation regarding regional population developments, dwelling unit occupancy, etc.

APPENDIX 2. THE TRANSPORTATION PLANNING INFORMATION SYSTEM

Funding: System development is financed by the Municipality of Amsterdam, which also operates the system.

System description: The system consists of about 200 software programmes, supplemented by standard data analysis packages. Main features include modules or macros for: the processing of household interviews at three levels; the processing of traffic counts (manual registration); logit type travel demand analysis, resulting in elasticities; public transport network assignments and line use analysis; road network coding and assignment models; origin-destination table manipulation programmes, including trip distribution and modal split forecasts; adjustment procedures for model-based assignments to traffic counts; and separate packages for project applications.

Hardware and software: The programmes run on a CDC mainframe (Cyber) computer, supported by intelligent terminals. Parts run on MS-DOS type microcomputers. The policy is to run data collection input, individual applications, and output presentations on a microcomputer. Demand analysis and citywide transport system analysis and forecasts run on the mainframe computer. Individual applications could run on standard transportation analysis software, but with Amsterdam elasticities.

Planning data base: Socioeconomic data for the base year and a standard future year (1995), provided by the other sectoral information system, a standard coded network for the Amsterdam GMA and elasticities.

Services by the system: Policy and project studies by users operating from the same organizational unit as the system manager. *Ad hoc* services to others.

APPENDIX 3. THE BUILDING-USE INFORMATION SYSTEM

Funding: System development is financed by the Municipality of Amsterdam, which also operates the system.

System description: The system is a combination of manual registration of data (on maps) and statistical processing of selected data items by a computer programme aimed at aggregate statistics. Recent and related developments include mapping of selected items in a geocoding system.

Hardware and software: The building-use data is processed on an IBM mainframe computer. The input is prepared by a Philips mini-computer. The geocoding system is a standard package running on a MS-DOS microcomputer.

Planning data base: The planning data base consists of manually prepared maps per building block, and the computer output consists of statistics to be manually addressed.

Services by the system: Information is provided for zoning plans and land-use control. Aggregates about building-use are applied in policy studies. Input about dwelling unit occupancy is provided for the population forecasting model.

11

INFORMATION PROCESSING SYSTEM FOR DISASTER MANAGEMENT

Hideki Kaji

INTRODUCTION

Disaster management is one of the most important issues in the field of urban and regional planning in Japan. Many kinds of natural hazards such as typhoons, heavy snow, earthquakes, and volcanic eruptions cause severe damage to the society and the people. In order to cope with such natural hazards, various measures have been taken not only in hardware improvement but also in software management.

Information processing system for disaster management is the most important software measure to be taken at the central and local government levels. Needless to say, the systems which will be necessary differ from one disaster to another. In general, however, the following three issues should be discussed:

(1) What kind of information should be transmitted in respective phases of a disaster?

(2) The origin and the destination of the information transmitted.

(3) How and by what medium should such information be transmitted?

This paper attempts to discuss the above issues in terms of a large-scale earthquake, which, it is anticipated, will hit Tokyo in the near future.

INFORMATION REQUIRED BY TIME PHASE

In any earthquake disaster mitigation plan, four time phases are significant: (a) Pre-earthquake phase; (b) warning phase;

(c) response phase; and (d) recovery and reconstruction phase (see table 11.1).

TABLE 11.1. INFORMATION REQUIRED FOR DISASTER MANAGEMENT

Time phase	Actions	Information required
Pre-earthquake phase	Earthquake resistance planning	. Data base . Community-scale assessments of area vulnerability
	Preparation for rescue and relief	. Estimation of seismic losses . Available resources
	Citizens' training	. Training programme for improving people's awareness on seismic risk . Knowledge-based information on earthquake
	Monitoring	. Precursors, such as land deformation, resistivity, foreshock, and others
Warning phase	Monitoring	- do -
	Dissemination	. Tsunami information for people's evacuation . Time, place, magnitude, and probability of the event
Response phase	Damage Investigation	. Collapse of housing, roads, bridges, lifelines, airports, harbours, and so on . Fire outbreak points and behaviour of spreading fire
	Evacuation control	. Population distribution on a real-time basis . Road conditions along the evacuation route
	Rescue and relief	. Available resources, labour force, and others . Required activities based on damage information

TABLE 11.1. (continued)

Time phase	Actions	Information required
Response phase	Temporary arrangement	. Available resources . Needs
Recovery and reconstruction phase	Damage investigation	. Total losses . Estimate of indirect influence
	Dissemination of people's safety	. Who is where and how? . Progress of relief activities
	Recovery and reconstruction	. Effective recovery programme . Reconstruction planning

Pre-earthquake phase

The pre-earthquake phase includes action to contain potentially disastrous effects on structures and facilities as well as preparatory work for postdisaster activities. Thus the aim of the information processing system in this phase is to provide useful information for prioritizing programme alternatives.

Preparation for a data base is essential. Disaster-related information should be collected as much as possible at different levels in each area, and preferably at the community level as the smallest unit. These data may be applied to assess hazard risks or the vulnerability of each area. The more detailed the data, the more accurate can be the plans. Tokyo Metropolitan Government (TMG) publishes "The Map of Area Vulnerability to Earthquakes" at five-year intervals. Establishment and preparation of physical and institutional arrangements for rescue and relief immediately following disaster exposure are also significant during this phase. Simulation exercises based on estimates of seismic losses resulting from the assumed earthquake (into which research is currently being carried out by the TMG), will be of great help in checking the availability of resources and the essential action to be taken during the response phase. With regard to citizens' training, the information processing system will play an important role in making people aware of what they should do in case of a disaster.

Some earthquakes are said to be predictable. Thus, in Japan, a high density observation network has been in place since

1973 in the Tokai region, where the next large earthquake is anticipated to occur. A variety of precursor-related data such as land deformation, resistivity, electromagnetic radiation, foreshock, and so forth,1/ is telemetered on-line on a real-time basis from several stations to the Japan Meteorological Agency (JMA).2/

Warning phase

This phase is significant just for a predictable earthquake of magnitude 8, or above, with clear precursors. If any anomalous changes are found in the data continuously being telemetered, public announcements of earthquake prediction will be made, based on the judgement of the Earthquake Assessment Committee. Such announcement includes the following: The approximate time of the predicted earthquake; the place, including a reasonably specific locality; the anticipated size or magnitude of the earthquake; and an expression of probability or certainty that the earthquake will occur approximately as predicted.3/

Response phase

This phase lasts for one or two days from the earthquake occurrence until post-earthquake fires which may have spread throughout the city can be extinguished.

The most important task for information processing in this phase is to collect certain pieces of information about damage on a real-time basis, such as destruction of buildings, bridges, roads, lifelines, airports, and harbour installations. In particular, information about the dynamic behaviour of spreading fires is essential for leading evacuees to places of safety.

In order to operate evacuation control properly, the following information is required: The times and places that the fire will spread to; the places where evacuation operations are necessary; existing population to be considered; operation commencement time in each place; and the road conditions along the evacuation route.

Information for rescue and relief activities will be derived from damage investigation, which will include a list of available resources.

Housing, medical centres, water services, and so forth, will have to be temporarily provided to the evacuees. Their overall needs and the availability of resources should be counted through the information processing system.

Recovery and reconstruction phase

Damage investigation must be continued throughout this phase, and final and authorized figures of the total losses, including the estimate of some indirect influence must be computed.

The most essential activity in this phase will be the dissemination of information about the people's safety, their location, and condition. Recovery activities of the respective agencies also have to be effectively disseminated to one another because a recovery of one function influences the others. Thus, an effective recovery programme should be considered. It is also important to understand that cities cannot always be reconstructed exactly as they were. Therefore, optional city planning should be discussed simultaneously during this phase.

MEDIA-SUPPORTED SYSTEMS

As hardware apparatus for supporting this information processing system for disaster management, the following communication media can be taken into account: Mass communication systems such as television, radio, and newspapers; telephone network system; data communication system; and radio communication system.

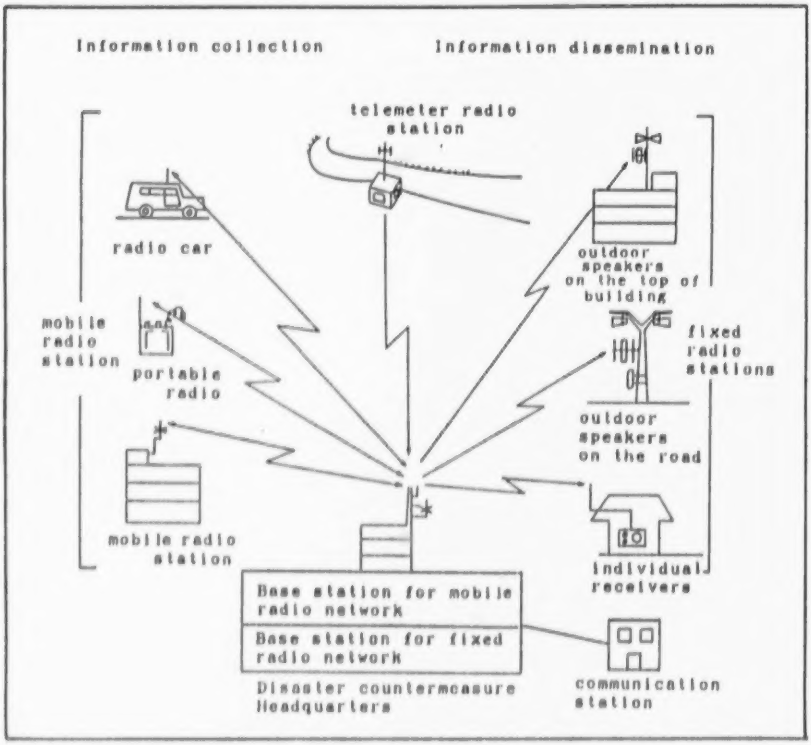
Mass and radio communication systems are important in places affected by the disaster. In Japan, the radio communication network for disaster management has been established at three levels of administration: (a) The Central government level; (b) the Prefectural level; and (c) the City and municipal level.

Figure 44 shows a typical radio communication network for disaster management at the municipal level.4/ As far as the fixed radio stations are concerned, 30 per cent of the municipalities have the systems established.

AN EXAMPLE: EVACUATION CONTROL SYSTEM ON A REAL-TIME BASIS

As an example of the information processing systems for disaster management mentioned above, this paper introduces the evacuation control system on a real-time basis, which is currently being developed under the name of RTS (real-time system) Project by the research team of the Building Research Institute, Ministry of Construction, Government of Japan.

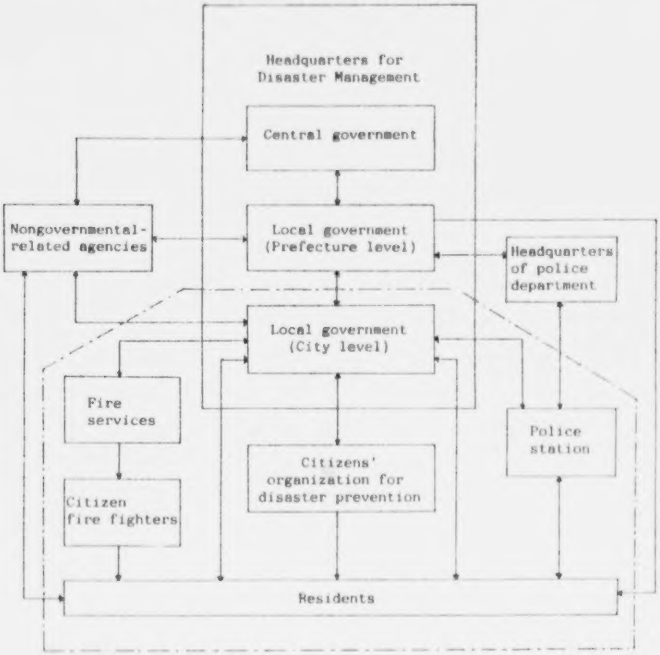
Figure 44. Radio Communications System for Disaster Management at City Level


Information collection
Information dissemination
telemeter radio station
radio car
mobile radio station
portable radio
mobile radio station
outdoor speakers on the top of building
fixed radio stations
outdoor speakers on the road
individual receivers
Base station for mobile radio network
Base station for fixed radio network
Disaster countermeasure Headquarters
communication station

The system is expected to be operated by local governments at city level (see figure 45). The outline of the system operation is illustrated in figure 46. As the figure shows, the operation of the system begins when a large number of postearthquake fires simultaneously break out. As the first step, fires which the fire services fail to extinguish and begin spreading are identified, and information about such fires is fed into the computer, together with the relevant data on observed damage. As the second step, the following two simulation models will be carried out:

(1) A model to estimate the dynamic behaviour of spreading fire in congested areas under particular wind conditions which is supposed to be inputted on a real-time basis; and

Figure 45. Related Bodies on a Real-Time Basis Evacuation Control System (Within Broken Line)

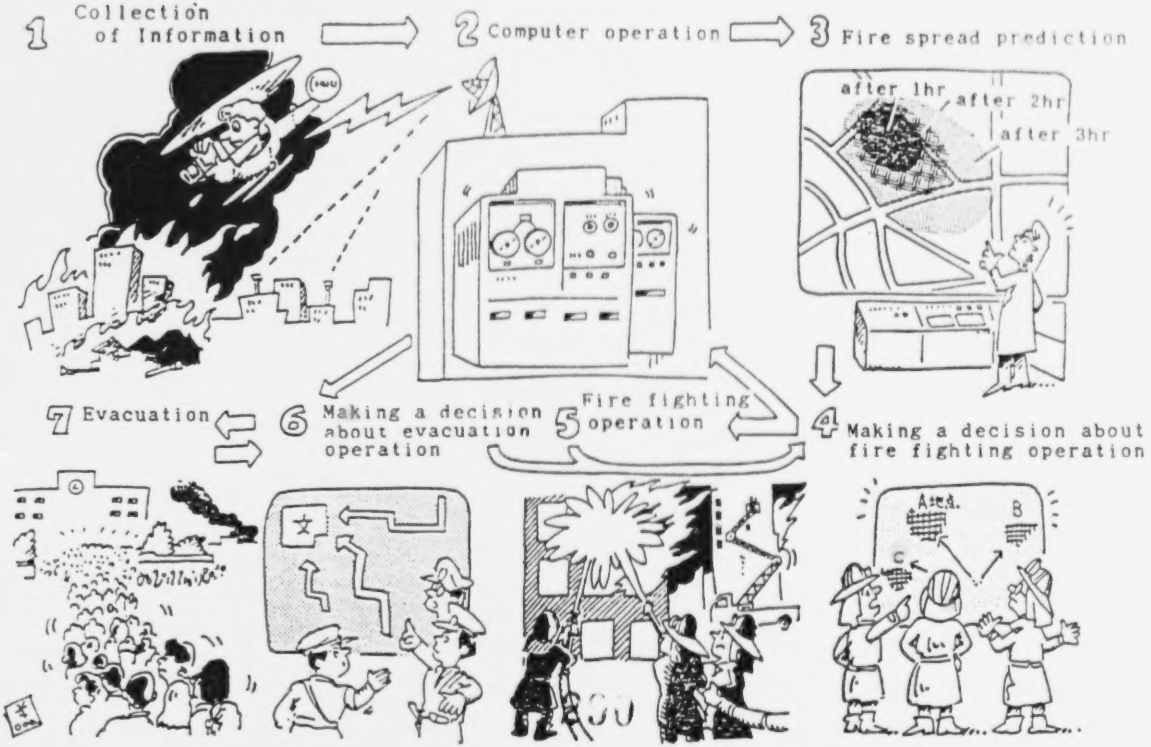

Headquarters for Disaster Management
Central government
Nongovernmental-related agencies
Local government (Prefecture level)
Headquarters of police department
Local government (City level)
Fire services
Citizen fire fighters
Citizens' organization for disaster prevention
Police station
Residents

(2) A model to calculate the latest departure time enabling residents in each district to safely evacuate areas affected or likely to be affected by fire.

These models incorporate automatic self-modification programmes to cope with changes in weather conditions, and to adjust the estimated data to the actual data which are observed on a real-time basis.

Results of the predictions will be transmitted to the headquarters of fire services and police departments. The fire services draw up operation plans to fight fires, placing priority on places where immediate action is most urgently required. Police departments map out strategies to control evacuees. Such action is expected to be completed within one hour at the most. This system will assist city mayors, who will be managing chairmen at the disaster headquarters at the city level, in providing warning and evacuation advice to residents. In this information processing system, two models mentioned earlier are essential. The basic structures of the models are as follows:

Figure 46. Real-Time Information Processing System (Illustrated by Hiromi Oda; Kagaku-Asahi, May 1985)


1 Collection of Information
2 Computer operation
3 Fire spread prediction
after 1hr
after 2hr
after 3hr
4 Making a decision about fire fighting operation
Area.
B
C
5 Fire fighting operation
6 Making a decision about evacuation operation
7 Evacuation

Spreading Fire Model

Figure 47 shows the algorithm of the model. One of the essential advantages of this model lies in its use of a polygon, which is called 'block' in the original model, surrounded by roads, railways, rivers, and open spaces, as a computation unit instead of grid system. This makes it possible for the evacuation control system to be directly connected without any conversion of information.

With regard to the prediction of dynamic behaviours of a spreading fire, the Hamada Formula will be employed. In order to avoid errors in estimation, which will accumulate as time passes, some adjustment programmes based on the regressive equation formulated by time series data observed on a real-time basis are installed (see figure 48).

Figure 49 is an example of the result displayed on CRT. Setagaya-ku, one of the twenty-three wards of Tokyo, is taken as a case study area. It covers 10 km^2 and includes about 4,500 blocks. Conditions characterized by a NNE wind and a velocity of 5 m/sec with four initial outbreaks of fire are assumed. Fifteen to eighty seconds of CPU time were required to run one case by FACOM 170F computer. This deviation is due to the location, the number of original fires, the wind velocity, and the wind direction.

Evacuation Control Model

When fire spreads uncontrollably throughout the city, evacuation to secure locations will be necessary. The models which have been developed before aimed to estimate the number of residents who might not be able to evacuate safely, or to compute the degree of danger in each area in terms of evacuation. Sufficient information on the time residents would take before leaving their homes for safe areas was crucial in these models in order to reduce loss of life. However, additional elements were considered, such as the difficulties ensuing if there was a simultaneous departure time one hour after the occurrence of an earthquake. If all the residents in one area evacuated at the same time, congestion on the roads would be extremely bad; this would entail loss of time.

Thus, an original model has been developed in this RTS Project with the aim of computing the critical initiation time for evacuation in a normative way. It indicates that safe evacuation is not possible if residents remain in their homes longer than the computed time. Such time is called "the latest initiation time for evacuation," or "the latest departure time for a safe

Figure 47. Algorithm of Fire Spread RTS Model

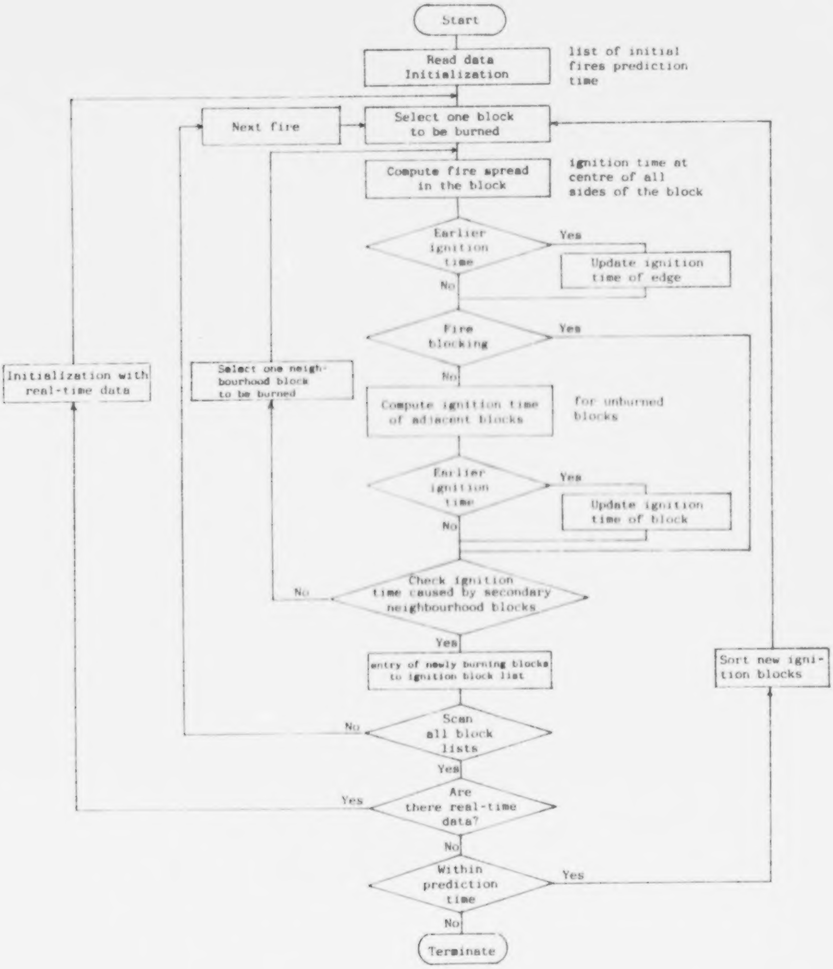
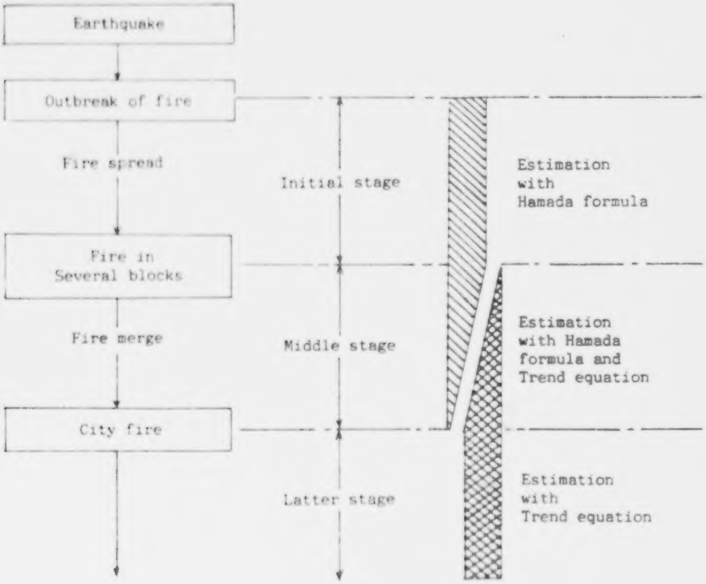

Start
Read data
Initialization
list of initial fires prediction time
Next fire
Select one block to be burned
Compute fire spread in the block
ignition time at centre of all sides of the block
Earlier ignition time
Yes
Update ignition time of edge
No
Fire blocking
Yes
No
Initialization with real-time data
Select one neighbourhood block to be burned
Compute ignition time of adjacent blocks
for unburned blocks
Earlier ignition time
Yes
Update ignition time of block
No
No
Check ignition time caused by secondary neighbourhood blocks
Yes
entry of newly burning blocks to ignition block list
Sort new ignition blocks
No
Scan all block lists
Yes
Yes
Are there real-time data?
No
Within prediction time
Yes
No
Terminate

Figure 48. Transition of Equation Adopted as ROS

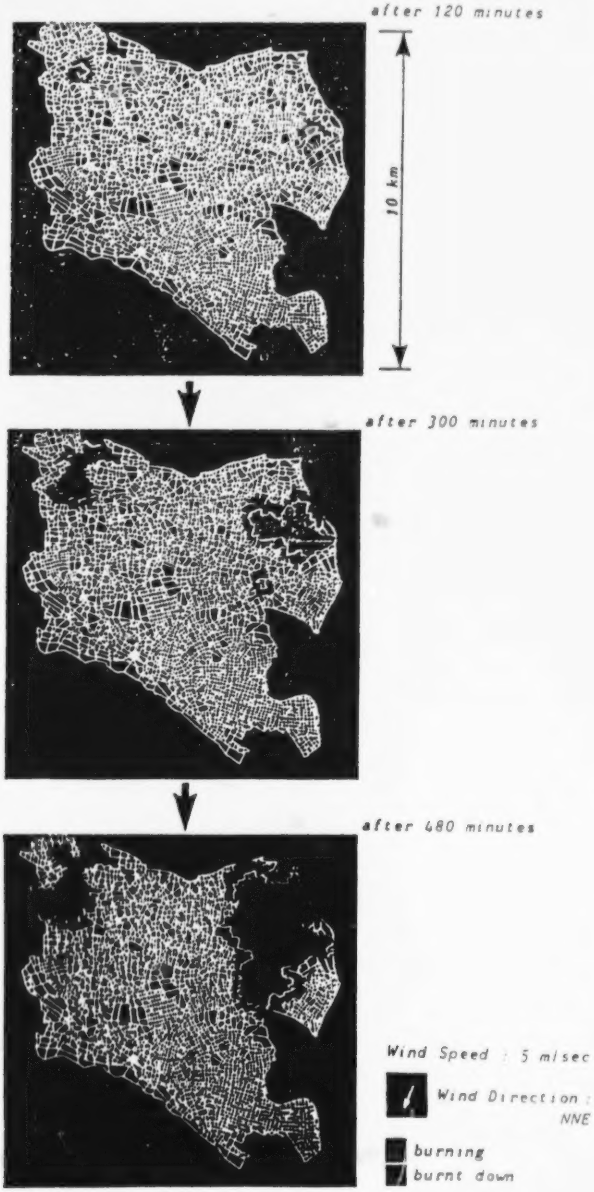

Earthquake
Outbreak of fire
Fire spread
Fire in Several blocks
Fire merge
City fire
Initial stage
Middle stage
Latter stage
Estimation with Hamada formula
Estimation with Hamada formula and Trend equation
Estimation with Trend equation

place." Although it may sound slightly dangerous, it must be understood that this concept does not deny evacuation earlier than the suggested time. It indicates the longest time that residents can remain in their homes. In general, people are likely to stay home as long as possible, because they wish to protect their houses from fire and also verify the safety of their families. The latest time for evacuation, therefore, must be regarded as a kind of guaranteed limit for their safety.

In addition, "the latest initiation time for evacuation" has another function. Simultaneous evacuation will cause congestion on key roads which will create delays and increase the danger. The "latest departure time" incorporates a coordinated time lag of departure for each district in order to prevent traffic congestion.

Figure 50 shows the general spatial relationship between fire and routes to safe areas. All the residents who are located at points further away than point 2 in the figure must traverse the evacuation route before the fire reaches that point and cuts the way. Figure 51 illustrates how the solution can be obtained, and figure 52 shows an example of the result. Careful examina-

Figure 49. An Example of the Output of the Fire Spread RTS Model


after 120 minutes
10 km
after 300 minutes
after 480 minutes
Wind Speed : 5 m/sec
Wind Direction : NNE
burning
burnt down

tion of the map will indicate the places where people must evacuate immediately after an earthquake, or even before. Such information will be transmitted to the fire services, who will compute how long they will be able to prevent the fire from spreading. The results will be modified in such a manner through interactive computation.

Figure 50. Assignment of Width of Roadway

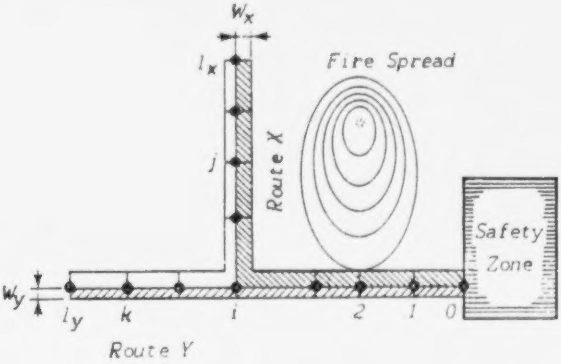

W_x
l_x
Fire Spread
j
Route X
Safety Zone
W_y
l_y
k
i
2
1
0
Route Y

Figure 51. The Latest Departure Time in Graph Form

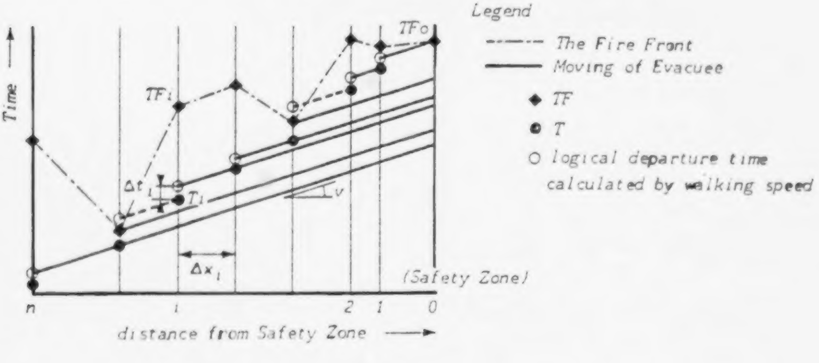
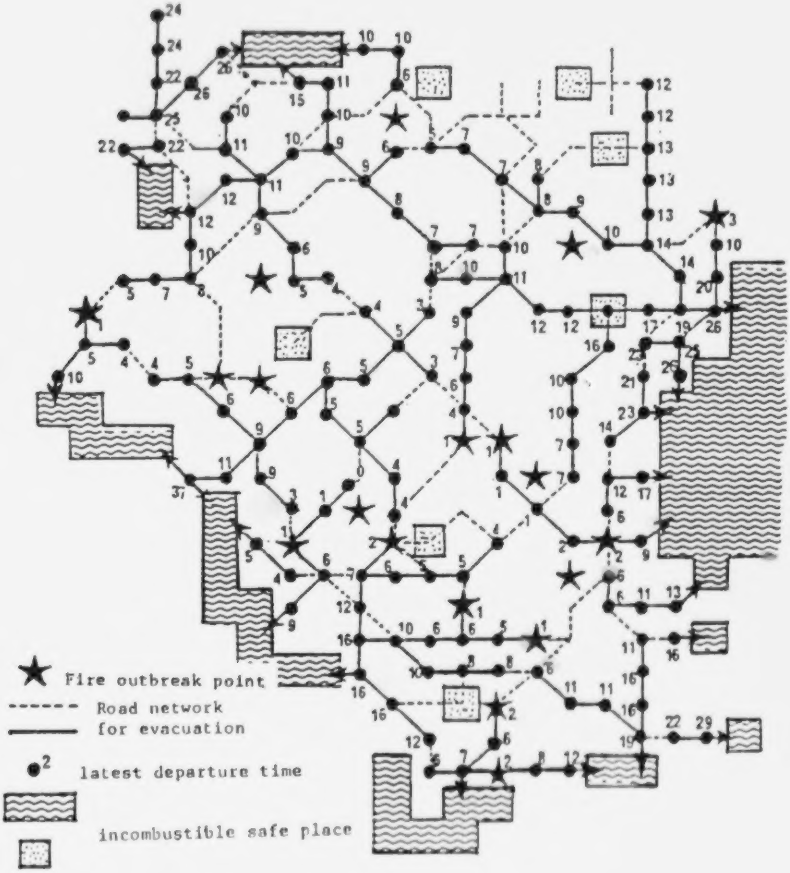


Figure 52. The Latest Departure Time


★ Fire outbreak point
------ Road network
——— for evacuation
●2 latest departure time
incombustible safe place

CONCLUSION

Currently, the usefulness of the information processing systems on a real-time basis is widely recognized. However, many problems remain unsolved. It is, therefore, suggested that further studies should be carried out from the following viewpoints in order to increase the possibility of application in the practical operation of disaster management. The issues which should be covered in the future are:

(1) How to collect information on the dynamic states of the disaster on a real-time basis in cases of emergency;

(2) How to input collected information into the computer within a restricted time; and

(3) How to transmit information calculated by the computer to each organization concerned as rapidly as possible.

NOTES

1/ T. Rikitake, "Earthquake Forecasting and Warning in Japan" (Paper presented at the International Seminar on Regional Development Planning for Disaster Prevention, Shizuoka, Japan, September 1986).

2/ J. Takagi, "Promotion of Observation and Research for Earthquake Prediction in Japan" (Paper presented at the International Seminar on Regional Development Planning for Disaster Prevention, Shizuoka, Japan, September 1986).

3/ D. S. Mileti et al., "Socioeconomic Impact of Earthquake Prediction on Government, Business, and Community (Report to the National Science Foundation, 1978).

4/ Institute of Future Engineering, *Communication Network for Disaster Management* (Computer Age Inc., 1985).

5/ E. Itoigawa et al., "Countermeasure Against Seismic City Fire with Real-Time Information Process" (Paper presented at the International Workshop on Regional Development Planning for Disaster Prevention, Shizuoka, Japan, September 1986).

PART III: TRAINING IN INFORMATION SYSTEMS

12

PROBLEMS OF IMPLEMENTATION OF AND TRAINING IN INFORMATION SYSTEMS FOR SUBNATIONAL DEVELOPMENT PLANNING

Ralph Adam and John B. Rose

INTRODUCTION

Multilevel planning, in which subnational planning functions are strengthened and harmonized with national-level planning, is now widely seen, particularly in developing countries, as a key factor in promoting equitable growth, in rationalizing national goals with local needs, and in promoting "grass-roots" participation in the planning process. Effective information systems are increasingly viewed as essential for the multilevel planning process, given the quantity of planning data for an entire country, the complexity of information flows between planning levels, and the planners' needs for specialized analysis.

Computers and other information technology can surely contribute significantly in this context, but there are many challenges and problems involved, particularly in selecting the appropriate technologies, adapting them to local situations, training specialized manpower, and sensitizing and training the users of the system. These problems are especially acute in developing countries, where skilled manpower is often insufficient at the subnational level and where economic and other constraints render more difficult the acquisition and dissemination of technology.

It is evident, moreover, that the above technical elements represent only a part of the solution in establishing effective information systems for multilevel development planning. Equally important are considerations of planning, organization and administration of the system, and particularly the coordination of its different components within the various planning levels and sectors concerned.

The following section will review several general considerations in developing information systems for multilevel planning from the viewpoint of the United Nations Educational, Scientific and Cultural Organization (UNESCO) programme, with particular emphasis on the Asia and Pacific region and the question of training. A number of considerations in the selection and implementation of information technology in this context will then be discussed in the next section, drawing on a preliminary experience in software evaluation with which the second author has been associated.

UNESCO'S ACTIVITIES

UNESCO has been very active in the area of information for development planning through its General Information Programme (often identified by its French acronym PGI), and especially within the framework of the UNESCO/PGI-sponsored Regional Network for the Exchange of Information and Experience in Science and Technology in Asia and the Pacific (ASTINFO), given the particular interest shown in this topic in the region.

Regional Seminar on Information Systems for Subnational Development Planning

This seminar was organized in Visakhapatnam, India, in December 1985 by the Institute for Offshore and Coastal Research (INCOR) with support from the Indian national authorities, the International Development Research Centre (IDRC), and UNESCO. It brought together planners and information specialists from both within and outside the Asia and Pacific region to help in defining information needs in subnational planning, to exchange experience on information-handling methods, and to initiate a framework for future cooperative efforts in the region in this area through the collaboration of concerned organizations at the national, regional, and international levels.

Three working groups were established during the seminar in order to cover each of the main levels of subnational planning: Local, Urban, and regional (provincial). A number of recommendations resulted from the groups' deliberations, of which the main ones can be summarized as follows:

1. Information structures should be embedded within the existing authority structures and administrative procedures, insofar as possible.
2. Standardization of data collection procedures and data formats should be emphasized, with a particular stress on geocoding as the basic common reference framework for planning data.

3. At all three levels, public participation and cooperation in data collection and evaluation are essential as a means of extending the availability of data. However, this should not prejudice the need for the utmost reliability in data quality.

4. The use of new low-cost technology: The gradual application of such tools as decentralized computer systems with graphical capabilities, remote sensing and aerial survey techniques, and automated data acquisition should be envisaged in keeping with priority information needs and the building up of national experience and capabilities.

5. Human and organizational needs must be recognized and training in the use, development, and maintenance of information systems should be given the highest priority at all levels.

6. Great attention to the analysis and presentation of data is necessary so that they serve user needs. The value of graphical techniques was again emphasized in this context.

7. A national-level institution or agency should be identified for the performance of the following tasks:

   (a) the training of technical staff;

   (b) the training of planners;

   (c) the initiation of exchange of information among the operators of different decentralized systems;

   (d) advice on hardware, software, and system design; and

   (e) the mobilization of resources for system development and evaluation, preferably with the assistance of international agencies.

8. Comparative study should be undertaken of those systems already in operation within the region so that the knowledge gained can be widely disseminated and unnecessary overlap avoided; it was recommended that a "regional cooperation programme" be initiated, with the collaboration of concerned countries and international organizations, to promote the development of information systems for subnational planning through concrete activities such as regional seminars and workshops and

assistance in the selection and application of information technologies, particularly through the establishment of a "global data bank on software."

It is interesting that many of these recommendations were similar to those of the 1974 expert meeting organized by UNESCO in Valescure, France, on the feasibility of extending UNISIST principles (the principles for standardization and harmonization of information systems promoted by PGI) to the social sciences and to those of the *Conceptual Framework and Guidelines for Establishing Geographic Information Systems* published by UNESCO in 1984.1/ However, the Visakhapatnam Seminar went one stage further and set out a declaration calling on governments of the region to develop and strengthen national information policies and recommending multilevel, decentralized planning as a means of achieving development and equity with self-reliance, through the establishment of authority structures supported by effective, economical, and compatible, computerized information systems. Furthermore, it recommended collaboration between the various planning levels through the creation of national focal organizations, a thrust towards regional cooperation in collaboration with existing international organizations and programmes, and efforts within each country to minimize duplication by establishing data banks on available data, software, and current and planned projects with free and open access to data on information-handling methodologies (but not necessarily to actual planning data).

The themes of the Visakhapatnam Declaration can be felt in several recent or continuing PGI projects, two of which are presented below as examples.

Pilot Project on a Microcomputer-Based Data System for Decentralized Rural Planning and Administration

This project, which has been carried out by the Government of Sri Lanka in collaboration with the United Nations Economic and Social Commission for Asia and the Pacific (ESCAP), UNESCO, and the Data for Development International Association, is now reaching the conclusion of its second phase. The project began as a result of legislative and administrative measures for the devolution of certain state functions in Sri Lanka to locally-based institutions, which made the organization of information systems at subnational levels an urgent priority. The existing government information systems had been centrally controlled, sectorally specialized, and vertically structured. In order to make planning and decision making easier at a local level, a horizontally-integrated information system (with a strong orientation towards local requirements) had to be established.

PROBLEMS OF IMPLEMENTATION OF AND TRAINING IN IS

In Sri Lanka, although decentralized planning is a recent innovation through the establishment of District Development Councils, administration has been locally based for several decades. Decentralization has resulted in each district (and the divisions within it) having local representatives of the major ministries to carry out administrative and regulatory functions coming within their purview. In the process, much data are generated and stored in files -- where they have often remained untouched and difficultly available to the new local-level planning apparatus.

The initiative for undertaking a pilot project for the establishment of a data system for village-level planning and rural development in one specific district (Kalutara) evolved from efforts to promote improved coordination and management of government information. A preliminary inventory at the district secretariat had suggested that a wealth of data in virtually every important sector existed in a form suitable for village-level analysis, relating for example to population, housing, agriculture, and industry.

The Kalutara district information system has been geared to long-term rural development objectives. During the first phase (1982-84), a microcomputer was installed at the district offices and the staff were trained and reorganized to develop the necessary skills for coping with the new technology. Technical support was provided, primarily by the central government, for the establishment of two administrative applications: Pension payments and the monitoring of projects undertaken with special development funds at the district level.

The first phase concentrated on subjects for which much expertise already existed, at least at the central government level. However, Kalutara is a rural district and the great need for specific information for management of local land and resources was not reflected in the data systems already established. Therefore, a study was carried out into the existing manual procedures for maintaining the register of land titles and related topographical information, with a view to linking the data to a geocoding framework and transferring the system to a microcomputer. In 1984, a second phase of the project was initiated, the main objective being to develop two computerized geographical information systems for the Horana division of Kalutara district. One of them was to be a population data base created from the 1981 population census records and the other a land-use data base created from the 1982 agricultural census records. In both cases it was decided to develop facilities enabling the district secretariat staff to retrieve information at the village level so that integrated village profiles could be established for administrative and planning purposes. It was also intended that, if the project was a success, it would be used as a model for extension not only to other divisions, but also to other districts in Sri Lanka and, eventually, to other countries within the region.

The activities of the second phase of the project have been devised so as to fall into five areas:

1. the installation and commissioning of additional microcomputer equipment, a digitizer, and a graphics printer, and the familiarization of the local staff in the operation of the equipment;

2. the training of local staff in the use of software and the development of a computerized geocoding system;

3. the organization of data for the input of base maps and creation of the two data bases;

4. the generation of useful output from the data bases; and

5. the creation of suitable documentation for the two computerized information systems.

The bulk of these activities have now been completed and are being evaluated. With the ending of the second phase, UNESCO's direct involvement will end for the time being -- although interest in the progress of the experiment will continue. A third phase has, however, been proposed by the Sri Lankan authorities and ESCAP with a view to implementing a computerized household register for the Horana division. Current plans are to stabilize the work already done by ensuring that staff are sufficiently trained and adequate in number (a particularly important problem in view of the scarcity of qualified manpower and the high cost of training replacements); to identify further applications in areas which are critical to local-level government; and to consider, at the national level, the dissemination of the successful applications and the creation of the necessary organizational environment for this purpose.

Training of Information Specialists and Users

Human resources are probably the most important single component of any developmental activity in the information field, and training and education are thus accorded particular attention within the UNESCO General Information Programme. In the area of multilevel planning, this implies the training and sensitization of many types of specialists: Policymakers, planners, development and systems analysts, information specialists, and so on. An integrated approach to training is needed, so that each group concerned receives appropriate attention and compatible instruction within a single overall framework. In the Sri Lanka project just described, this was managed by using national and international consultants to train operators in the necessary techniques for the work and to devote time to "sensitizing" managerial and other senior officials so that they know what the system can and cannot do and how they can support or benefit from it.

With a view to providing a general training tool in this area, drawing upon the experiences gathered in diverse national and institutional contexts, PGI has collaborated with the Data for Development International Association in the preparation of an extensive training kit on the establishment, coordination, access to, and utilization of socioeconomic and administrative information systems. The kit is primarily intended for those in charge of training decision makers and other officials who are involved in the provision and use of data for national and subnational planning. It is designed in such a way that it is suitable for use in different types of training sessions, and its modular form allows for a great deal of latitude in the organization of seminars and in the way the information is presented. It is not, however, intended for practicing specialists (e.g., computer scientists, librarians and documentalists, statisticians, or cartographers) as they are assumed to have sufficient background knowledge and require a much more practical and technical type of training; some parts of the kit could, however, be useful within the basic education curricula for these types of specialists.

The training kit, which was conceived as a loose-leaf collection of transparencies, is supported by an instructors' manual providing general guidelines and specific advice on the presentation of each module. It consists at present of eight modules, although more may be added later. These modules cover the following topics:

1. Government information systems (examples);
2. Information and information transfer: General considerations;
3. Information systems (introduction to technical aspects);
4. Evolution and tendencies in information system design;
5. Information needs for subnational planning;

6. Maps and graphics as tools for statistical presentation;

7. Geocoding and information systems; and

8. Strategies for management of information systems and for access to and diffusion of information.

Throughout the kit, the use of information for local planning needs is emphasized.

Detailed recommendations are given for using the kit for training three categories of personnel:

- Senior decision makers, primarily heads of government departments, who have the power of decision in matters concerning information systems; they are primarily interested in overall strategy considerations.

- Lower ranking officials whose departments either use information systems (e.g., planning departments) or supply information to them (e.g., those responsible for field activities); they need to understand information systems as a whole in order to contribute to and benefit from them.

- Administrators responsible for setting up information systems (managers of statistics services, computer centres, documentation units, etc.); they are more concerned with operational aspects and ensuring that their systems respond to users' needs.

Model schedules and curricula are proposed for five-day courses for the above audiences; in each case the eight modules can be used, and each module contains advice on presentation of its material to trainees in the different categories. As an example figure 53 gives the suggested schedule for a course for system managers, including practical work and examples drawn from the local situation and needs (which should provide about 50 per cent or more of the course material); for this audience it is envisaged that module 2 on information theory can probably be omitted. A similar course for senior decision makers is foreseen as covering all the modules but at a lesser degree of technical detail with emphasis placed on the strategic aspects of management (module 8) and tendencies in information system design (module 5). For users and information providers one might deemphasize some of the technical material (e.g., modules 3 and 4) and managerial considerations (module 8) in favour of more practical work and examples of information system use.

Figure 53. Suggested Schedule: Seminar for System Administrators

DAY 1	DAY 2	DAY 3	DAY 4	DAY 5
Welcoming of Participants	Module 3 First Part Factual I.S.	Module 3 Second Part Bibliographic I.S.	Module 4	Module 7
Module 1			Various I.S. Architecture Presentation	Examples of Geocoding Systems
Lunch				
Examples of Government I.S.	Examples of Factual I.S.	Examples of Bibliographic or Retrieval I.S.	Module 5	Module 8
	Full Management Tools (Practice)	Data Bases Access and Use (Practice)	Module 6	Final Evaluation

This type of seminar is seen as most effective for a maximum of about fifteen participants of similar responsibility. Mixed groups of trainees with different fields of interest (e.g., users and potential system administrators) could be considered, depending on local situations, but the authors of the kit caution against bringing together participants with widely varying levels of responsibility. If the seminar is to run over several days (as is usually the case), a residential setting is recommended to promote informal interchanges and decrease unwanted distractions. It is recognized that in many situations, and particularly for senior decision makers, a five-day course may not be possible, but a minimum of three days' duration is recommended.

A preliminary version of the training kit has been produced in English and French, and PGI is interested in locating a small number of institutions willing to test it as part of their own training programmes. Already, interest in the testing of the English version has been shown by institutions in India and Thailand, and it is likely that several organizations in Africa will test the French version. Once testing is complete, the kit will be finalized for wide dissemination, taking account of comments received on the preliminary version. Any major gaps in coverage can subsequently be filled in through the addition of extra modules.

Another UNESCO/PGI project involving a more technical level of training in information systems for subnational development planning is currently in the early planning stages. It concerns the creation of a regional software demonstration and training centre for Asia and the Pacific. A feasibility study has recently been completed but no definite arrangements for a location have been made as of yet -- although current plans favour India. The availability of such a centre should facilitate the evaluation and testing of specialized software packages, as well as providing training in their use for the countries of the region.

COMPUTERIZATION

Information needs for subnational planning are generally interdisciplinary and highly varied, and thus cannot be easily categorized. One common characteristic is, however, that information and data needed for planning activity at a given geographical/hierarchical level (regional or provincial, district or block, municipal, local, etc.) are generally collected at that level or a lower one, but also serve in aggregated form for baseline studies, formulation of development targets, and monitoring/evaluation at higher levels. Another characteristic is that the spatial distribution of the various parameters under consideration must generally be known and analysed for detailed planning at any level. For these reasons most computerized information systems for subnational planning either require, or could be significantly improved by, the application of specialized techniques for manipulating, presenting, and exchanging geographic or map-based data. This implies the use of geo-referenced data bases containing consistent information on the spatial location of the various entities of interest to planners (population, infrastructure, land resources, etc.) as well as the traditional data (such as socioeconomic indicators or land-use parameters) associated with these objects.

In addition, for the purpose of choosing an information system to satisfy the needs of a particular planning situation, one may enumerate a limited number of general information functions which may be handled by the system:

(a) Automated acquisition and exchange of computer-readable data and/or digitization of input data available in manual form such as survey maps.

(b) A data base management system (DBMS) to provide for storage, management, and retrieval of data.

303

(c) Utilities for commonly required manipulation and analysis of data, including statistical analysis.

(d) Data display including graphical and cartographic presentation.

(e) Facilities for utilizing (and perhaps developing) specialized models or simulation routines appropriate to the particular planning application. Examples are network analysis, location/allocation analysis, definition of zones/catchment areas, regional interaction models, and calculation of physical and engineering parameters.

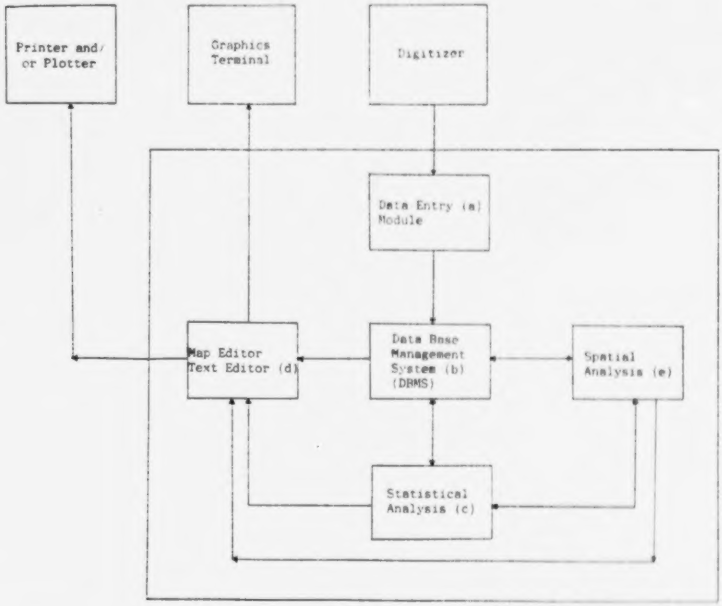
Most planners will require each of the above functional capabilities to varying degrees. The first four functions, which can be considered as the core, may be provided as elements of a single software package or as separate but compatible software modules. The relationship among the components is shown in figure 54, where the DBMS function is placed in the hub position because of its central role in organizing and providing data for the other functions. Except in rare cases where the needs are relatively simple and clearly circumscribed from the beginning, a single package cannot be expected to adequately satisfy them, and an appropriate degree of "openness" of the basic system to external packages and data must be sought. This is particularly true when specialized models are envisaged as an aid to the planning activity (function (e) above). If the handling of geographic data is foreseen, one of the critical factors to consider in selecting or developing software is the geographic referencing framework which is very important for compatibility with external systems as well as for internal integration of data and will be discussed in more detail below.

Hardware Considerations

Although a very big data base or one with a large number of simultaneous users or exceptional calculation requirements may require a mainframe computer, a minicomputer, or even a "PC-type" microcomputer (a professional level model with a 16-bit or more powerful processor) can now effectively serve for many data base applications including geocoded data bases for planning. Some special hardware needs will probably have to be considered, however, in setting up a geographically referenced data base, the two most important of which concern data input and data presentation.

For graphic presentation, a graphics terminal will be required; in a single-user micro a standard graphics monitor may

Figure 54. Components of a Software Package for Subnational Planning


Printer and/ or Plotter
Graphics Terminal
Digitizer
Data Entry (a) Module
Map Editor Text Editor (d)
Data Base Management System (b) (DBMS)
Spatial Analysis (e)
Statistical Analysis (c)

suffice, but high-resolution graphics (at least 200k pixels), normally enabled by a special adapter card, should be foreseen if at all possible. For output, many normal printers with dot-mapping capability can produce attractive maps and other graphic displays, but for more stringent needs (high volume, publication-quality output, etc.) a more specialized printer or a plotter may be required. Colour graphics are generally more highly appreciated by users than monochrome graphics if employed effectively, and may be required in some applications. Regarding input, a digitizing aid will surely be needed if a large amount of data is to be taken from hard-copy maps.

The Geo-Referencing Framework

The geo-referencing framework is the protocol by which data are spatially identified in a geographic data base or information system, including the definition of a set of basic geographic entities for the region under consideration and rules for describing the geographic location of data in terms of these entities.

The two principal conceptual approaches employed in specific systems are the "grid-cell" method and the "segment" or "polygon" method. In the former approach all data are referenced to cells in a grid of basic areal units which fills the entire space under consideration (normally a latice of identical squares or rectangles). In the latter method, areas or regions are defined in terms of the lines or "segments" which form their boundaries and, in a similar manner, linear and point features can be described by their actual coordinates.

Although software can be developed to transform grid-based data to a polygon reference system and vice versa (albeit with a certain loss of accuracy) a given system should always make use of a unique geo-referencing framework for identification and storage of data. All data sets within the system will be referenced by this framework, and it is thus very important to choose it carefully as this choice will have considerable impact on the way data can be input, retrieved, displayed, and exchanged.

The main advantages of the grid-cell approach are:

- It is conceptually simpler than the polygon approach and computer programmes are easier to develop and maintain.
- Density values in a region, as well as some types of analyses involving regional interactions, are easily calculated.

The main disadvantages of grid cells are:

- The nature and position of point and linear features are not well described since all data are referenced to areas of finite size.
- There is a loss of accuracy in describing real areas such as administrative or natural regions when they are approximated as composites of grid cells.
- Topological information relating spatial features to each other is not explicitly stored so that particular models which make use of these relationships, such as network analyses, are not easily accommodated.
- When a space containing many grid cells is used to improve accuracy, it may become difficult or impossible to effectively store and retrieve the data.

It might seem from the above discussion that the polygon approach, which stores only the minimum amount of data required to describe a given spatial entity, which is based on "real" rather than artificial areas, and which automatically includes topological information, would be the ideal one in most situations, but in fact grid cells are often quite adequate or even preferable for some applications such as natural resources planning where flexibility in data manipulation and integration is often of primary importance and where geometric accuracy is not extremely critical (as opposed for example, to applications such as town planning where a high degree of spatial accuracy is required).

Approaches to Software Acquisition

There are three basic approaches which should be considered in acquiring software for subnational planning:

(a) Selecting a comprehensive package which is already operational.

(b) Acquiring a number of separate modules which perform the various functions required, and interfacing them together.

(c) Developing a package either from scratch or starting with available modules and/or prototypes.

The first approach is generally the most efficient one, providing that a satisfactory package exists and can be acquired and maintained within the available budget and the constraints of the local situation.

The second approach may also be fruitful but it must be expected that the interfacing of the modules selected will not be perfect and may involve a fair amount of complexity.

The third approach is the most costly one in terms of time and manpower but may be advantageous in special situations, for example, when appropriate packages are not available at affordable cost, when highly specialized needs are concerned, when a package can be developed for a large number of user institutions, or when this approach is justified on the basis of research or training objectives.

It should be stressed that the relative economics of the above approaches will depend to a large extent on the scale of application of the proposed system and on the existing framework into which the system must fit. For example, the selection of a package for use throughout an entire country or province will pose problems of compatibility and opportunities for economy of scale which may not be present in considering computerization for a single municipality. Similarly, a decision to integrate the computerization of planning functions and of administrative functions at the local level would, on one hand, lead to a more complex computer system with the problem of competition for use but, on the other hand, could result in useful sharing of software, data, and experience.

Results of a Preliminary Software Evaluation

Following the 1985 UNESCO-sponsored Regional Seminar on Information Systems for Subnational Development Planning, the Institute for Offshore and Coastal Research proposed to establish a regional evaluation and demonstration centre for software for subnational development planning. Pending a reply from UNESCO on this proposal, work was begun in September 1986 at the INCOR to establish such a centre at the national level, involving one temporary fellow and ultimately two members of the Institute's research staff. It was decided to emphasize local-level (and urban) applications in this preliminary effort since this was felt to be the greatest need in developing countries in the region where central (and to some extent provincial) planning functions are often already supported by computerized techniques. In this context, IBM PC-compatible software was targetted for the initial evaluation efforts because:

(a) Microcomputers are widely seen as an effective, low-cost solution to establishment of subnational planning information systems, and a number of projects in India and other countries in the region had already been initiated with this type of equipment.

(b) IBM PC-compatible computers have become a *de facto* standard in many countries of Asia and are widely available from local manufacturers in India and several other Asian countries.

(c) The INCOR had at its disposal several of these computers with appropriate peripheral equipment.

Inquiries were made concerning software which could be made available at nominal cost and/or in local currency to begin the project and four packages were identified for initial testing:

(a) The prototype PC version of the Map Analysis Package (MAP), developed at Yale and Harvard universities, which had been provided free of charge at the Workshop on Digital Geographic Information Systems Using Microcomputers, organized at the Asian Institute of Technology (AIT), Bangkok, in June 1986.

(b) The Urban Data Management System (UDMS) of the United Nations Centre for Human Settlements (Habitat), also available free of charge.

(c) The Spatial Analysis and Automatic Data Processing Information System (SALADIN) developed by TNO in Delft, the Netherlands, and provided free of charge to the project for a period of three years.

(d) The readily available AutoCAD package which had been used extensively for thematic mapping in a cooperative programme in Sri Lanka by the Division of Human Settlements Development of the AIT which offered to provide interface software developed for cartographic input as well as training in its use.

MAP and SALADIN are respectively grid-cell based and segment-based geographic data base packages which provide for thematic mapping and a number of types of planning analyses functions. UDMS is a segment-based package which also carries out a number of planning analyses and presents regional data in map form.

It was felt that the above packages provided scope for a diversified preliminary experience with different types of software as outlined above. One additional package which was not tested directly but was used as a reference is the Geo-encoded Resources Integrated Data System (GRIDS) software, a grid-cell based package developed by the INCOR itself and being introduced in several district-level planning units within the Natural Resources Data Management System (NRDMS) sponsored by the Government of India. A PC version of GRIDS is foreseen but was not available for testing.

Furthermore, contacts were initiated with the Spatially-Oriented Referencing Systems Association (SORSA), which agreed to assist the INCOR in establishing a software information and documentation centre. At the time of completion of the initial evaluation activity, this collaboration had not yet yielded concrete results.

An attempt was made to test the available packages using insofar as possible the same set(s) of real data appropriate to subnational planning. It is evident that the results obtained in the first seven months of the project are only of a partial and very preliminary nature, due to the time and staff limitations as well as to the narrow selection of software available and the fact that the initial efforts did not involve interaction with real users (planners) on software performance. A few tentative conclusions will, however, be presented below.

The three PC packages which have been specifically designed to handle geographic data for planners (MAP, UDMS, and SALADIN), were all in the development stage at the time of the evaluation but the latter two can be considered as nearly operational. MAP would be most appropriate among them for use in physical planning applications (assuming that the operational version of the package is obtained or further local development work is undertaken to finalize the available prototype; SALADIN would be useful mainly for urban planning including applications involving detailed street-address level data; and UDMS could be applied in various decentralized planning situations which are not highly demanding in terms of data volume or geo-data complexity. GRIDS was originally designed for retrieval and presentation of natural resources data at a fairly large map scale, but may well prove applicable in other situations when finalized for dissemination. None of the packages can be considered as having a generalized data base management and exchange capability (although SALADIN pays particular attention to managing the geographic base files), and it is likely that users would require a traditional data base management and statistical package in parallel to input and manage the attributes associated with the geographic entities.

AutoCAD and similar draughting packages can be practical for producing high-quality thematic maps for planning, using digitized base maps and attribute data for the geographic entities under consideration which can readily be maintained by a separate data base management package. However, this approach does not provide a geo-referenced data base accessible to the user, and therefore would not be sufficient if one requires spatial analysis or any significant amount of manipulation of geographic data (e.g., polygon overlays); it is essentially limited to the presentation of existing attribute data in a manner which can be better appreciated by planners.

With the exception of UDMS, the packages tested cannot be said to be user-friendly in the sense of being able to be handled by a planner with limited time for using the system, little experience in computerized techniques, and probably only intermittent needs for information. Similarly, none of them provides significant guidance for the inexperienced user on the pitfalls or errors which could result from blindly relying on the results of a given analysis. It would thus seem recommendable that planning units wishing to make use of this type of package should foresee the participation of a specialist with a background in spatial/statistical analysis and training in the package(s) under consideration; the latter practical training could generally be conveyed in a short course of one to two weeks for candidates with an appropriate background, but for others a lengthier period would certainly be required.

PROBLEMS OF IMPLEMENTATION OF AND TRAINING IN IS

Although the packages examined, and the functions that they offer, appear to be potentially useful in subnational planning situations, each was seen in its present form to have certain drawbacks or difficulties. In addition, these initial packages were selected to a large extent on the basis of availability and cannot be considered as representative of the many microcomputer-based planning aids which are becoming available. It would thus seem essential to test a number of additional packages, stressing those which are fully operational and reasonably complete and sophisticated, as well as those being implemented for planning purposes in developing countries, with a view to identifying a number of available packages which could be used effectively in various planning situations and are acceptable from the viewpoint of cost and user support. Tests should be carried out in real planning situations, in addition to conducting a standard evaluation according to a checklist of functions and performance indicators.

This endeavour might best be carried out as a continuing cooperative effort of concerned institutions, notably in Asia and the Pacific, who could help to ensure that the results are regularly disseminated, perhaps in the form of a newsletter and/or a software data base, and that technical support for and training on the software identified are made available to potential user organizations.

It should be underlined in conclusion that the present analysis has emphasized, of necessity, the technical evaluation of microcomputer-based software in the context of its potential usefulness to an individual planner, and has not considered the interrelationship of software needs at different planning levels. This latter aspect is a very important one which depends upon the scheme of planning responsibilities at the national level as well as on the information system structure to be set up within this administrative context; it should be carefully considered along with available technical information in assessing options for computerized assistance for planners and ultimately selecting software for this purpose.

NOTE

1/ See Document PGI-84/WS/20.

APPENDIX 1. DETAILED EVALUATION RESULTS

The characteristics of the packages considered during the current project are summarized below in tabular form, including an overview of the testing experience for each.

1. Map Analysis Package (MAP), IBM PC version (prototype)

Background and general description:

This package was originally developed for use on a mainframe computer as a student project at Harvard and Yale universities, and is now being developed by the original designer as a PC application. It provides a number of functions for entry, storage, manipulation, and presentation of cartographic data stored in grid-cell format. These operations are accessed by a command language with natural language syntax. A number of innovative spatial functions are provided which characterize geographic clusters or neighbourhoods (by size, shape, etc.) or the properties of a geographic surface (distances over real terrain, paths of steepest descent, line-of-sight calculations, etc.) Other functions provide for traditional thematic mapping analysis.

Producer:

C. Dana Tomlin
Laboratory for Computer Graphics and Spatial Analysis
Harvard Graduate School of Design
Cambridge, MA, U.S.A.

Cost/Availability:

It is understood that the IBM PC version will shortly be available from the producer on a commercial basis. A prototype version (source and object code) was made available free of charge for training purposes in 1986; the following details relate to this prototype version rather than the operational version of the authentic package which was not available for testing.

Hardware required:

IBM PC compatible computer with at least 320KB memory and a colour graphics adapter for graphic display of map data. An 8087 co-processor is recommended for speed considerations.

Software required:

MS-DOS operating system. The source programme is in FORTRAN. Preliminary graphic display facilities (not available in the original prototype) have been written at INCOR in 8086 assembly language.

Size of data base:

The prototype version tested supports 10,000 grid cells (320KB memory) and could be used up to about 64,000 grid cells (384KB memory). Fifty attribute maps are supported for each data base but this could be increased indefinitely depending on available mass storage.

Summary of the evaluation:

Since available prototype presented several problems which made it inappropriate for extensive testing, the source code was debugged and somewhat improved (principally with the addition of a graphical facility) for the evaluation exercise.

A test was then conducted with village-level socioeconomic and infrastructure data on Ramayampet Taluk, Medak District, Andhra Pradesh, available from the 1971 and 1981 census exercises, combined with topographic and locational data taken from Survey of India topo-sheets. During the evaluation, the following additional weaknesses became evident (listed in order of decreasing importance):

(a) There is no facility for statistical analysis of data (cluster analysis, analysis of variance, etc.) which means that the results are often limited to empirical or intuitive calculations.

(b) A number of functions are quite slow for interactive use and the number of grid cells per map which may be handled effectively is likely to be insufficient for many real applications.

(c) There is no facility for the interlinking of data bases and only very limited possibilities for integrating map data at different scales.

(d) The command language is difficult to master due to the rigid order required in word sequence and the large number of unique command sequences to remember (the commands are primitive which do not correspond to the elementary functions required by most end-users).

(e) A number of bugs exist in the prototype. The presentation of data (particularly graphical presentation) requires considerable improvement.

The conclusion was that although the package is very innovative, particularly in taking care of many potential data analysis needs in land use management and physical planning, the available prototype is not suitable for operational use by planning agencies. In this context, it would be useful to contact the system developers with a view to testing the operational version of the package if and when it becomes available. On the other hand, the package in its present form should prove very useful in training and demonstration activities on geo-information systems, such as those already organized successfully at the AIT.

2. Urban Data Management System (UDMS), version 5.2

Background and main features:

The UDMS package was written in the late 1970s as a model for handling urban data on the then prevalent 8-bit microcomputers operating under CP/M. The latest version, distributed in Autumn 1986, has been completely rewritten for use with IBM PC compatible computers.

The package is completely menu-driven and allows for (manual) input of map-based regional boundary (polygon), point and network data and provides facilities for multivariate correlation analysis, gravity model fitting, point-in-region searching, optimal location of facilities and shortest path analysis, as well as map presentation of the data.

Producer:

United Nations Centre for Human Settlements (Habitat)
P.O. Box 30030, Nairobi
Kenya

Cost/Availability:

The source code is available free of charge from UNCHS (Habitat) for professional use, subject to signature of a license agreement forbidding its sale to third parties. Copying, modification, and further dissemination are permitted, subject to constraints specified in the agreement. The package is being tested and used in a large number of institutions, particularly in developing countries.

Hardware required:

IBM PC compatible microcomputer with 256KB internal memory and preferably two disk units. A colour-graphics adapter is required for the mapping functions.

Software required:

MS-DOS and Microsoft BASIC (version 2.0 or above). The producer recommends use with interpreted BASIC but users are invited to see if compilation would improve performance (a compiler was not available to test this in the present study).

Size of data base:

The package is dimensioned to handle 999 map boundary points, 48 regional variables, and unlimited point files of 48 nodes each, but dimensions of each could be increased several times if necessary. Networks must have less than about fifty nodes to be processed within available memory.

Summary of the evaluation:

A test of UDMS was carried out using the same data which were used for the test of the MAP. The package is, on the whole, reliable and extremely easy to use. A number of drawbacks were, however, identified and are listed below in order of decreasing complexity from the viewpoint of system development:

(a) There are facilities for handling only one layer or level of region, and thus no selection of the boundaries to be displayed is possible (except the choice of displaying or not displaying all the regional boundaries).

(b) There are very few possibilities for linkage of polygon, network, and point data in analysis and presentation. In addition to constraining the types of analysis which can be performed, this results in duplicate entering and storage of data (e.g., a point might have to be entered three times as a boundary point, a locational point, and a network node).

(c) The models provided are not very elaborate and may be unsatisfactory for many real users. Some of the calculations are also extremely slow, perhaps due to limitations of interpreted BASIC.

(d) There are no possibilities for manipulation or generation of thematic regional variables (e.g., calculation of population densities from regional populations, and generation of multivariate indexes).

(e) There is no allowance for automated input, and the procedures for manually entering data are very tedious; there are no facilities for checking, correcting, or updating the geographic base file.

(f) The graphical display of maps allows no flexibility for the user in selection of style, colour, etc. No names of regions or other geographic elements can be displayed.

It would seem that, although UDMS should prove very useful as a demonstration/training package and in some operational situations, it may well prove insufficient in many real planning contexts. A weakness in the urban planning area is its inability to handle detailed data at the level of streets and addresses.

A number of minor bugs were removed by the evaluators; these modifications were conveyed to the producer and have been presumably taken into account.

3. Spatial Analysis and Automatic Data Processing Information System (SALADIN), version 2.03 (November 1986 prototype)

Background and main features:

SALADIN is a modular segment-based software package for the management and analysis of spatial data in planning, which was originally developed for mainframe use and has now been converted for use on microcomputers. The standard package handles digitization, updating, and maintenance of attribute data, a number of types of data processing and analysis (aggregation, area calculation, descriptive statistics, shortest path calculations, determination of catchment areas, location-allocation models, and interfacing with external software) and thematic mapping of point, segment, and polygon-based data on matrix printers or plotters.

Producer:

Jan P. van Est
Section IRIS
Study Centre for Urban and Regional Planning, TNO
P.O. Box 45, 2600 AA Delft, The Netherlands

Cost/Availability:

The package used in the present test is one which was still in the final stages of development. The operational package was expected to be available in Spring 1987 under an annual license fee of US$1,250. Source code will not be available.

Hardware required:

- IBM PC compatible microcomputer with 512KB of internal memory, an 80(2)87 mathematical co-processor, a graphics card, and an optional colour video display. A winchester disk is strongly recommended.
- A digitizer from among about ten for which the package is currently adapted.
- A matrix printer and/or plotter chosen from among a number of supported models. The package was originally adapted for use with Hewlett-Packard plotters and some plotting routines for customized output only operate with this equipment.

Software required:

- MS-DOS operating system
- Graphics System Extension (GSX) of Digital Research Corp.

Size of data base:

Limitations not clear from documentation.

Summary of the evaluation:

Insufficient time was available to thoroughly test the many features of this package, and efforts were hampered by difficulties in using available peripheral equipment. The evaluation was thus limited to testing with a small amount of simulated data.

The digitizing module was given particular attention and was found to be very effective and versatile and relatively easy to use (despite some minor bugs in the prototype tested).

In general the package in its present form cannot be considered easy to use because of the many separate programmes which must be run by the user, including several to be run sequentially for some functions. Even with an improved user interface the package would remain complex, and it is difficult to envisage its being effectively employed by casual or inexperienced users.

The particular strength of SALADIN is its handling of very detailed (street-address level) data for urban planning applications. Its use in regional and rural planning, or in physical planning for towns and smaller settlements, may be limited by its complexity and by certain features of the geographic model adopted (for example, it is apparently not possible to include in the data base linear features which are not connected to, or part of, a polygon).

4. AutoCAD, version 2.17

Background and main features:

AutoCAD is a generalized computer-aided draughting application for microcomputers. The package alone is not readily usable for cartographic work since there is no proper provision for dealing with superimposed polygon boundaries. However, if the digitized data are pre-treated by appropriate interface programmes before entry into AutoCAD (version 2.1 or above), high-quality cartographic output can be produced using thematic data transferred from a standard DBMS (such as dBASE III) or statistical package (such as SPSS).

For this purpose, a set of programmes for digitization, pretreatment, and transfer of cartographic data has been written by the staff of the AIT, Bangkok.

Producer/Availability:

AutoCAD is produced by Autodesk, Inc. and is commercially available worldwide through local dealers.

For information on obtaining the companion programmes used in this evaluation, one could contact:

PROBLEMS OF IMPLEMENTATION OF AND TRAINING IN IS

Lakshman Yapa
Department of Geography
Pennsylvania State University
State College, PA 16802
U.S.A.

Division of Human Settlements Development
Asian Institute of Technology
G.P.O. 2754, Bangkok 10501
Thailand
Attention: Nizam Uddin Ahmed, Research Associate

This approach is being used operationally in several districts in Sri Lanka with guidance and training provided by the AIT.

Hardware required:

IBM PC compatible computer with 512KB internal memory and either two floppy disk units or (preferably) one floppy and one winchester disk.

AutoCAD works with a wide selection of video displays, digitizers, and plotters, and with a lesser number of graphics printers.

Software required:

- MS-DOS version 2.0 or above
- AutoCAD ADE-3 option which permits use of "polylines"
- Microsoft BASIC (version 2.0 or above) for use of the companion packages written by the AIT.

Size of data base:

The drawing being edited should fit into core memory, which does not normally pose a practical restriction. Although it is possible to "attach" attributes to geographic entities in AutoCAD and to retrieve them according to specific (textual) values for given attributes, this facility would probably be insufficient for any significant data base or information retrieval functions.

Summary of the evaluation:

The approach to using AutoCAD for cartographic output was studied during a mission to the AIT in Bangkok in early December 1986. A few more tests were performed at the INCOR using simulated map and attribute data, during which time the feasibility of using the package with the digitizers and plotter of the INCOR was confirmed.

There is no doubt that AutoCAD can be used to provide very high quality cartographic output for subnational planning. The principal drawbacks in this approach are:

(a) The package is rather complex to use, is relatively expensive, and contains many features which are not required for this type of application.

(b) It must be linked with a separate set of interface programmes as well as a DBMS and/or statistical package, making the production of thematic maps a rather tedious process.

(c) The geographic data base intended only for access by AutoCAD itself is not readily available to the user for planning applications such as network analysis or location/allocation models.

5. Geo-encoded Resources Integrated Data System (GRIDS)

Background and general description:

The GRIDS package was developed by the INCOR in the early 1980s to facilitate the integration and use of natural resources data and relevant socioeconomic parameters in multilevel planning. It was designed for use on a microprocessor-based computer (HCL System 2) and employed in a number of natural resources studies and planning data bases, notably at the district level. Following a operational test of the package with planning data on Medak District, Andhra Pradesh, a planning data base is being implemented for Visakhapatnam District as one of five pilot projects within the Natural Resources Data Management System (NRDMS) sponsored by the Government of India which ultimately aims to cover all the districts in the country.

The GRIDS package is a grid-cell based geographic information system designed to handle data in the NRDMS format. Its main function is retrieval of geographic areas conforming to multiparameter criteria and presentation of the data as thematic maps.

Producer/Availability:

Requests concerning GRIDS may be addressed to the producer:

Centre for Remote Sensing and Information Systems
Institute for Coastal and Offshore Research (INCOR)
Andhra University North Campus
Visakhapatnam 530 003
India

Hardware required:

The present package requires a HCL System 2 microcomputer with an ordinary line printer for map output. A new, more portable version is being developed for use on a Indian Zenith SC Minicomputer (not related to Zenith Corp. in the United States).

Software required:

- HCL BASIC interpreter (the package is being converted to FORTRAN for the new version which should be able to run a variety of mini- and microcomputers without much further modification).
- dBASE III (or equivalent) for data entry.

Size of data base:

The data base is limited by the amount of mass storage. However, data are stored in separate files which are presently limited to 64 attribute variables describing a 50 x 50 grid-cell region.

Summary of the evaluation:

It was not possible to make a comparative evaluation of GRIDS due to the heavy use of the original system for operational projects and the difficulties in directly comparing results from the present GRIDS data base set up on a 2.5' grid with the 0.5' grid selected for testing the other packages in the context of local-level planning.

One major disadvantage of the package is that only line-printer produced output is available for thematic maps (although the new version of the package will make use of graphical characters to improve the quality of output). Furthermore, GRIDS is only designed to perform basic data base management and thematic mapping functions and thus would have to be supplemented by other packages or further developed if additional analysis or modeling is foreseen.

13

EDUCATING PLANNERS IN INFORMATION TECHNOLOGY: EXPERIENCES FROM DEVELOPED AND DEVELOPING COUNTRIES

Michael Batty

INTRODUCTION: THE EMERGENT INFORMATION SOCIETY

The radical transformation of modern societies through the development of information technology since the advent of the computer in the mid-20th century is often compared with the development of the printing press in the mid-15th century. Daniel Bell1/ who popularized the notion of the postindustrial society, uses this analogy to emphasize the all-pervasive nature of the new technology but it is only in terms of the dissemination, storage, and retrieval of information that the analogy holds. A more dramatic comparison is with the development of writing for it is now clear that the really creative development of information technology involves processing information, in short in computing new information, transforming and manipulating data, thus involving qualitative as well as quantitative change.

The development of writing is so deeply embedded in our culture and consciousness that we do not have a clear picture of its impact. In fact, its development was so gradual that it is fruitless to speculate on the transition that took place and thus it is not possible to use the analogy to speculate on the impact which the present revolution in information technology is having and will continue to have. Although the notion of computing goes back into the history of mathematics, its formal embodiment in the technology of the computer less than fifty years ago has led to a change so fast and so pervasive that we are only beginning to appreciate its consequences. Despite this rapid change, once the revolution has run its course, information technology and computing will be simply part of the background to everyday life, and there is no reason to think that it will be any less pervasive than writing and printing. There is even a chance that it may be more pervasive, embracing art and music as well. In time, education and training will be widely based on such technology, it will suffer the same problems of literacy which plague writing and verbal expression today, and it will be organized into general and specialized areas. Nevertheless, because we are centrally involved in the transition to such an information age, it makes sense to study its impact and to prescribe how far information technology should be managed, particularly here in the context of urban and regional planning.

Although the technology of the computer is separate from the idea of computing, they represent an inseparable development in which one is not possible without the other. Computing and its technology have had a massive impact on industrial society through automation so far, but increasingly this impact is through the development of new ways of communication. The popular characterization of industrial society giving way to post-industrial society, where all basic material wants are produced by a small fraction of the workforce,2/ is given an even more dramatic emphasis by Toffler in his argument that this represents only the third wave or period since prehistory, following settled agriculture, then industrialization. The shift from energy to information, or from a society based on locomotion to one of "infomotion" as Nijkamp and de Jong3/ describe it, imply an even more radical change which will have enormous implications for the structure of society as well as for any policymaking or organized action in changing that structure. In particular, it is not only computing and the computer, but its synthesis with new forms of electronic communications which comprise the new information technology or "telematics".4/ A new social infrastructure based on such communication is being established, both freeing labour from mundane, routinized tasks and releasing people to engage in education, which itself is highly dependent upon a sophisticated awareness of the technology. Indeed, it is already clear that to fully participate in the information society, the population will have to be trained to a much higher level in basic communications skills than exist at present. This is clear, for example, in the difficulties noncomputer-literate individuals have with electronic mail, public information systems, and suchlike general-purpose technology.

The information society is also likely to be a much more heterogeneous structure than has been commonly supposed. Increasingly, portraits of the near future envisage undesirable information-based societies, and such diversity is already being reflected in the fact that a marketplace for information is being quickly established. Information, so long regarded by many as a "free" or at least "public" good, is becoming tradeable, value can be added to it through analysis and processing, and it can be communicated over global distances. Networks for its access are controlled by information brokers, and a situation of a society based on information-rich (those with access) and information-poor (those without access) is rapidly emerging.5/

The speed at which this change is being accomplished constitutes a major problem of adaptation. The shock posed by such radical change in terms of the introduction of hardware and software represents a critical problem for many individuals and organizations, especially for the majority who have little prior experience of computation. Such issues will be central to this paper where we will concentrate on the problems of becoming computer literate and on the massive increase in opportunities for processing and communicating information which the new technology brings. These are not problems for developing countries alone. The shocks experienced by the developed world are just as great, although different in scope and effect. We will also emphasize the sorts of organization which information technology brings in its wake. Nijkamp and de Jong6/ refer to this as "orgware" and the success of introducing new hardware and developing new software is highly dependent on new forms of "orgware."

The way Western societies are now moving to a postindustrial culture was never very clearly predicted by the futurologists such as Bell7/ and Toffler.8/ These predictions failed to anticipate ideological or value change which is strongly influencing technological change. Since the end of the postwar boom in the late 1960s, there has been a reassertion of the primacy of the individual, a new emphasis on market economics, and pressures by society-at-large to "roll back the frontiers of the state." In short, self-interest has become fashionable once again and the public interest has become less significant. These forces are very complex but the issue is particularly relevant to urban and regional planning, which, in Western societies, is an established function of the state and at present under severe scrutiny. In response, planning is becoming less strategic in focus, more entrepreneurial, and more locally based. A good example is contained in Manheim and Schofer's9/ proposals for a new style of responsive transportation planning.

These changes, however, pose particular problems for assessing the impact of information technology on planning, and for the education and training of planners in its applications. For a rational assessment of such educational possibilities, a clear view of the planning task environment and the way in which information technology can be applied to it is required, so that appropriate education can be identified. If this task environment itself is changing, the application of and education in information technology becomes uncertain. Already, there have been quite profound changes in the role of information technology in planning since the 1960s, when strategic, long-term applications were to the fore, in contrast to today when short-term, more routine applications are being emphasized. This is just one example of the more difficult general issue that the emergence of an information society involves the intersection of both technological and ideological-social change in complex and convoluted ways, leading to surprising, novel, and unanticipated effects.10/

Out of this context emerge several themes which will be addressed in this paper. In previous discussions of education and training in information technology for planners, particularly in the two meetings sponsored by the United Nations Centre for Regional Development (UNCRD) held in 198411/ and 1986,12/ there was a sense in which the issues concerning training were clear and homogeneous. The emphasis was upon information systems around which such training could be focused. In this paper, we will argue that the issues concerning training are nowhere straightforward, that the planning task environment itself is highly diverse, and thus that many different varieties of education are required. This, of course, has been widely recognized, for example by Masser and Wilson,13/ but we will not seek to provide a grand scheme for such training; we will emphasize particular questions and take the general context as given.

Accordingly, the focus here will be narrower than in many previous papers which have comprised the UNCRD project on training in information systems technology for planners. We will emphasize our experiences in teaching and disseminating information technology to planners in formal academic environments, and we will detail certain examples rather than propose massive agenda for training. We will also set this in a very broad discussion of information technology in planning, emphasizing that there is a continuum of information technology from the most rudimentary to the most sophisticated. Indeed, the prospect now exists of an "alternative" information technology founded on very cheap computing. The impacts of different levels of information technology, however, all involve changes in habits, changes in organization to support the technology, and changes in what is possible. As Sundaram14/ illustrates: "... what we are dealing with here is nothing less than a powerful 'technological avalanche' which is unstoppable because of its innate dynamism...." We will examine in some detail the shock involved in such change. Finally, we will urge caution. The constraints already identified on the adoption of and training in such technology involving capital, finance, skill, and availability of appropriate hardware and software, will all be taken as given but we will argue that the technological choices are difficult and complex everywhere, and that progress towards an information society is uneven, and never as remorseless as the pundits often imply.

We will first begin with definitions, of information technology itself, but also of education and training. In focusing on education, we require a model of the typical planning task environment, and once introduced, we will then demonstrate how information technology can and is being applied in practice.

Although our discussion will be in terms of experiences from developed societies, we will be very conscious of the transfer or otherwise of the conclusions reached to developing countries. We will then digress a little and sketch the kind of ideological change taking place in the transition to postindustrial society, and how this is combining with technological change to induce severe shocks into established systems and practices. In particular, we will focus on changes in hardware and software in our own academic environment, emphasizing the difficulties even of assessing, let alone absorbing all the opportunities now available for applications. We will then recount some experiences in developing packaged software for teaching planning students from developed and developing countries, but in an academic environment. We will particularly emphasize the difficulties in adapting general-purpose software to new tasks and new contexts, and conclude by once again, emphasizing the long-standing dilemma over whether to teach planning students information technology in depth or in terms of awareness only. Our general conclusions, however, concern the way in which new skills must be engendered. Building little by little, from the bottom up and gradually and slowly, appears to be the only successful training strategy which can meet the rapid changes which will continue in information technology over the next two or three decades. We will also speculate on how far these ideas can be transferred from academic to more practice-based planning contexts.

DEFINITIONS: INFORMATION, TECHNOLOGY, EDUCATION, AND TRAINING

We have already indicated a threefold characterization of information technology. In terms of activities, the use of computers creatively or for purposes of control involves computing, and is typically illustrated in software. Computing can involve qualitative change in information, but this is accomplished on computers or in terms of hardware. Computing and computers, software and hardware, although separable conceptually and in terms of use, operation, and development, act symbiotically and cannot be separated in terms of the evolution of information technology. The third component represents the organization or "orgware" which represents how the hardware-software structure is implemented.

Hardware-software represents a basic building block, which when extended into a network of such blocks represents the very infrastructure of information technology itself. Communication of information in various forms represents the essence of information technology, and this convergence of telecommunications, electronics, and computers is opening up dramatic possibilities for new types of creative computing, even in the most routine of tasks. How this infrastructure is being developed depends upon the tasks to which it is being applied, from the most routine to the most strategic. Moreover, the development of this information or "wired society" as Martin15/ originally referred to it, is altering the way we use information, not only in quantitative terms but also qualitatively. This will be a recurrent theme which runs throughout this discussion and we will return to it later. It represents a conundrum in that the very environment we are changing through planning is becoming a product of information technology (the wired society), just as the way we are able to explore how to change it is influenced by that same information technology.

Traditionally, information systems and control paradigms in planning have not been exclusively related to information technology. Since the development of systems theory, a couple of generations ago, planning has been based upon a model of information processing in which information has served to integrate the various tasks or stages comprising the planning process. The development of information technology represents a realization of this integrating force, which involves not just the substitution of previous forms of communication for the new electronic media, but a massive complementation of functions. Related to this is the dissemination of the building blocks through miniaturization, which is leading to strong decentralization of functions which are now computable but traditionally have been centralized. This picture of decentralization and integration, which we will refer to here as "decentegration," represents the third stage in the computer revolution, according to Manheim,16/ involving the use of computer tools and software in creative ways by end-users intent on solving their own problems. Just as the information society is increasingly a self-service society, computing is becoming highly individualized with the appearance of much general-purpose software which can be applied to a variety of tasks.

In a sense then, information technology is becoming increasingly diverse and heterogeneous, as it is adapted to specific and general tasks by users acting out many different roles. Miniaturization and the dramatic fall in costs of computer memory are both leading to much more specialized computer equipment, as well as the global diffusion of general-purpose machines. As we will show in a later section, many different types of hardware exist in a teaching-research environment, while the proliferation of various types of network indicates the increasing number of distinct roles which are emerging as the new technology develops. We will identify various roles in which planners might interact with the technology later, but the diversity of hardware also extends to new means of inputting and outputting, or communicating information involving scanning, remote sensing, expert systems interfaces, graphics systems, and so forth. We will see that applications in planning are beginning to reflect this diversity, and this will clearly need to be reflected in education and training. Different levels of software are beginning to appear generally, as well as specifically in planning, and training will clearly have to reflect these. But so will the organization of the planning task environment, and we will consider this in the next section.

We also need to be clear about the distinction between education and training before we proceed. The terms are often used interchangeably and we will continue to do so, but, specifically, education in this context will refer to more general and universal skills which are required to use information technology, in contrast to training which will refer to specific software applied to specific tasks. Although the emphasis here will be on programmes which seek to educate rather than train, largely because the academic environment from which these experiences are culled is nontask-orientated, it is usually difficult to disentangle education from training due to the need to develop specific task-related skills in a more general context. The essential difference between the education and training of planners in academic and practice-based environments relates to the nature of the task, often "hypothetical" in the former context in contrast to the "reality" of the latter. Another important distinction, however, is that in academic environments, learning by trial and error is the medium of instruction, and this is clearly less appropriate in practice. Educating planners in information technology in this context will refer more to inculcating awareness, reflection, and general-purpose skills which can encompass the range from learning about general-purpose software packages through to high-level programming, but we will exclude any experiences drawn from education and training relevant to specific tasks in practice-based contexts.

One issue which will emerge time and again in this discussion involves the use of different types of software, implying the need for both education and training within the pursuance of a single task. For example, in teaching students how to write programmes for modeling and forecasting urban activity patterns based on spatial interaction concepts, general-purpose software for displaying and drawing map output, for inputting data, and for debugging the programmes themselves are all used. A variety of skills are thus developed in any single example ranging from the most elementary, for example, keyboard skills, learning how to deal with pop-up menus and suchlike, through to more sophisticated techniques.17/ Awareness and general skills which are transferable are inculcated rather than specific skills on packages designed for specific practical problems. For example, we will not be referring to the sorts of skills required to operate geographical or planning information systems which are usually more appropriate to specific problems, and thus normally available only to practice rather than academia.

To summarize then, although education and training cannot be easily separated in any context, the emphasis here will be on education on nonspecific tasks carried out in academic environments, in contrast to training in specific tasks carried out in practice which represents the other extreme in this threefold continuum. Nevertheless, these experiences are transferable in large measure from one context to another. Many of the skills imparted in educating planners in information technology in an academic context are directly useful in practice, and this is evidenced by the large number of training programmes for practitioners which emanate from academia. For example, Masser and Wilson's18/ discussion of four levels of information technology and systems training from policymakers through to analysts contains education, which is widely available in academic environments; what is more important here, however, is discussion of the education and training for the technical professional in contrast to the policymaker and analyst. Policymakers require an awareness of new technology and some exposure to end-user skills, analysts require programming and even deeper computer skills, but the middle ground of the technical professional requires exposure to both, and to new ways of containing and organizing what has already been designed by computer experts. This is the area which we will emphasize in the subsequent discussion, but before we approach this, we need to discuss the sorts of tasks characterizing planning and the way information technology is being and should be applied to such tasks.

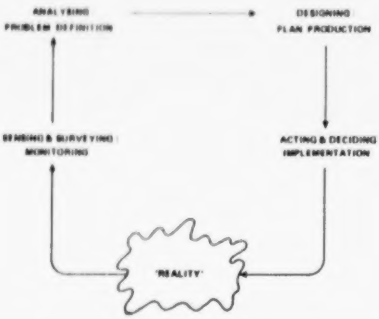
A MODEL OF THE PLANNING TASK ENVIRONMENT

The logic of this argument is to first examine the tasks which comprise the activity of planning, and discuss how information technology can aid such planning, this being a preliminary stage in identifying the type of education and training required. This is an obvious approach, although it is much complicated by the fact that there is no consensus in the nature of the task environment itself, and, consequently, ideas about training are rather volatile. Indeed, this is a result of technological and social change itself which is the very activity which leads to this discussion. Nevertheless, a starting point is required and thus we will begin by outlining a set of minimally acceptable tasks which comprise a typical Western planning system, the example chosen being Britain. This system is one of the most complete and organized in the industrialized world and, although it no longer exists in its original form in Britain, it is a stable model on which to assess information technology. It can then be brought up-to-date, and developing countries' planning systems can be examined.

The legislative planning system in Britain involves the control of land development mainly through physical instruments designed to achieve social and economic objectives relevant to the public interest. Planning is achieved through both positive and negative instruments. Positive actions involve initiating direct changes to land development, while negative actions control what is being proposed, both reinforcing one another symbiotically or at least as the theory presumes. Positive actions involve the preparation of plans, typically at strategic levels dealing with urban structure at the macro-level, and community-facility location at a lower district level. A fairly well-developed hierarchy of plans exists which are updated every five years. Negative controls ensure that the "natural" development of the system keeps within the bounds set by the plan. Development proposals are adjudicated upon at a much more frequent rate than plans are prepared, making such control more routine than the plan-making which guides the control. A well-developed system of laws and constraints exists in this development control process which enables, at least in theory, a match or compromise to be achieved between what is demanded and what is needed to account for the public interest. In theory, the two systems inform each other; in practice, there is much more emphasis on routine functions and much less on the strategic focus, and there is considerable role differentiation between the various parts of this planning system. Only in a few cases have attempts been made to organize processes which match the time frame of strategic thinking to that of development, usually involving some continuous process of plan preparation, implementation, and monitoring using notions of strategic choice.19/

Another feature of this planning system relates to its theoretical rationale in systems theory and management science. The theory is loosely referred to as the rational decision model and involves a continuous cycle of observation, interpretation, analysis, design, implementation, and further observation and monitoring of the impact of the proposed design.20/ Four tasks comprise this cycle: first, there are monitoring or sensing problems in the urban scene and this comprises the observation-data collection phase. This is followed by analysis of problems, problem definition, and the setting of goals. Designs, solutions, or plans which alleviate the specified problems are then proposed, a best plan selected, and then implemented in time. At the end of this cycle, the process begins again and, in theory, continues indefinitely. In practice, several such processes can exist side-by-side, not necessarily in phase but usually each informing one another. The activities involved comprise sensing or surveying, analysing, designing, acting, and deciding, and the cycle is illustrated in figure 55.

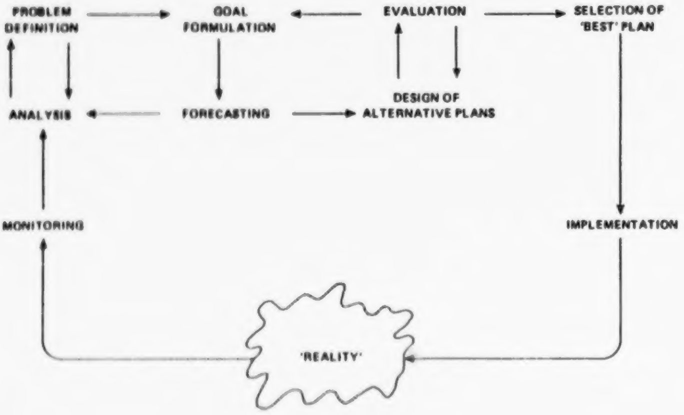
Figure 55. The Cyclic Planning Process



As the model has been elaborated, the line from problem to plan is much disaggregated, drawing heavily on structured problem-solving analogies in the decision sciences, and involving further cycles, around which the planner may proceed, wander, or explore until some progress towards the solution or plan is detected. Initially, the process is concerned with better problem definition or specification through analysis of the information, which ultimately leads to the specification or formulation of goals and objectives. Usually alternative solutions which reflect these goals are postulated, designed, or invented, and a "best" plan or solution is selected by evaluating these alternatives against the prespecified goal set. During this process, views about the future system are made using forecasts and speculations and these serve to contain the problem and its solution within feasible limits. Once the best plan is selected, it is implemented and it changes the system which itself is being influenced by other "nonplanned" forces. This change is then monitored and, if problems are detected, the cycle begins once again.21/

This process which is illustrated in figure 56 is more complicated than any diagram can portray, although such complications always embody extensions to the form described. Each of the stages identified, particularly implementation and monitoring, may be the subject of a further, deeper cycle of rational problem-solving, thus indicating a hierarchy of decision making in methodological terms. Mapped onto this is a hierarchy of plan-making with statutory plans in a British context at at least two levels -- city and district -- structure and local plans. In essence, the interlocking of these systems in hierarchical terms has never been well-worked out, although in practice the situation very much reflects this complexity. If there is a natural starting point to the cycle, it is sensing or monitoring, and in some characterizations of the process, information is seen as the hub around which the whole process is driven, affecting analysis, forecasting, and design.

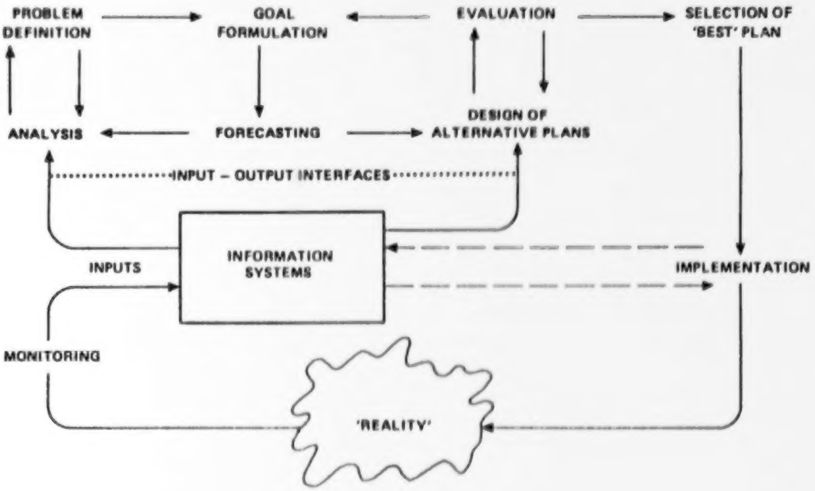
Figure 56. The Sequence of Tasks in the Planning Process



It is clear that information technology can affect all stages of this process. Information concerning what is happening is required, at whatever stage the process is initiated, and if a complete cycle is followed through from whenever such information is collected, the processing of this information affects all stages either directly or indirectly. Figure 57 organizes the process described in figure 56 in terms of the explicit development of an information system, and as such represents a fairly complete characterization of how information systems and technology might influence the planning process. Of course, in practice, large-scale information systems of the kind depicted here may not exist even though information is used in the process, and information technology is used in analysis, forecasting, and design. Many variants on this structure may exist with respect to partial developments of the model, as well as all the complexities of the process noted above.

It is worth examining the key elements of information technology in this illustration. First, there is the information system itself which is subject to all the principles relevant to efficient data storage and retrieval, and it is relevant to note

Figure 57. Information Activities and Systems in the Planning Process


PROBLEM DEFINITION
GOAL FORMULATION
EVALUATION
SELECTION OF 'BEST' PLAN
ANALYSIS
FORECASTING
DESIGN OF ALTERNATIVE PLANS
INPUT – OUTPUT INTERFACES
INFORMATION SYSTEMS
INPUTS
IMPLEMENTATION
MONITORING
'REALITY'

that this system has a dual role -- in monitoring change which is a routine matter, and in providing information for the key activities which comprise the planning process. These activities of analysis, forecasting, and design are likely to involve quantitative computer modeling of various kinds, but increasingly qualitative information will be part of the information system, and hence subject to new forms of computer analysis. The arrows into and out of the information system relate to the input and output functions of computer-based systems. Input data are still largely collected manually and entered similarly, but increasingly data, particularly spatial or map data, are being entered using semi-automated scanning procedures, as well as fully-automated remote sensing methods. The output of information involves numerical computations traditionally, but increasingly in plain language terms and using graphics. But the most important feature of these systems at the present time is the development of interfaces regarding the way the user interacts with them. Intelligent interfaces -- expert systems -- are increasingly available for enabling unsophisticated end-users to grapple with the information system directly with respect to entering data and interpreting output. Moreover, users are also being regarded as experts in their own right, and systems are being devised to incorporate such expertise into analysis, forecasting, and design, following the true spirit of man-machine interaction.

We have sketched a maximal model of information technology within a minimal model of the planning process, but this does serve to impress upon the reader the potential integrating power of information technology in such processes. However, in reality, the development of such technology is invariably less integrated. Local adaptations of the process make such complete integration virtually impossible to achieve, but it is the temporal differences in the operation of different phases of the process which do most to alter this. The strategic planning function illustrated in the top phases of figures 55 to 57 occurs infrequently, usually once every five years or so, in contrast to the monitoring function which is continuous. Consequently, it is rare for information systems to be developed which serve both functions. Development control systems are being developed quite separately for the more routine functions of day-to-day monitoring, and although various aspects of information technology relating to spatial input-output and expert system interfaces are accompanying such developments, such systems are not being developed with the longer phase strategic planning function in mind. Few, if any, information systems exist for plan-making *per se*. Usually, information becomes an adjunct to the computer-based activities of analysis, forecasting, and design which are accomplished separately from any integrated information system which may exist at the monitoring level. Indeed, in practice, the day-to-day monitoring function rarely provides data for the strategic planning function, although the potential for such integration does exist. Large-scale information systems which intended such integration have been attempted a generation or so ago, but the technology was not then present to support them.22/ Geographical information systems (GIS) have not been applied in physical planning as yet, although the prospect does exist for their development as part of the strategic planning function.23/

It has been assumed that the task environment is the domain of a single agency responsible for its integration. In fact, many agencies exist at different levels, each operating some variant of the planning function and this often involves a multitude of systems with elements in common. Other agencies involved with related public and even private sector planning problems are also involved in developing information technology which could benefit from coordination and common systems. In particular, a variety of agencies require census data for their functioning, and the prospect does exist for information technology to serve a much wider integrating function with respect to the public and private sectors generally. Another feature of the task environment is the emergence of initiatives and issues which do not fit the execution of this rational model. Agencies are often designed to cope with the implementation, justification, testing, and/or elaboration of "plans" and "proposals" which do not emerge from the rational decision model. In fact, the continual construction of new information technology to serve new articulations of existing or previous problems as well as new problems, is a much more characteristic picture of how practice is reacting to new technology in contrast to the ordered, homogeneous picture painted here. This is reflected as much in the fact that information technology itself is rapidly changing, and combined with social change, new problems, new agencies, and new organizations designed to cope with and apply information technology are contributing to this diversity.

There is one final point to note before we launch into a discussion of how information technology is being adopted in planning practice, and this concerns the complexity of various phases in the task environment. The collection and efficient storage, presentation, and retrieval of data, is clearly a much less controversial activity than many of the analytical and design activities of the strategic planning process. Information collection is a routine activity in many agencies, and thus the application of information technology in this area is more likely to gain acceptance. It is easier to demonstrate savings of various kinds in this context, although total savings in cost terms are largely illusory in the context of information technology developments, as will be argued a little later. Information *per se* is also more tangible than the products of its processing in terms of analysis and design, and thus it is not surprising that tasks associated with monitoring and information systems are in greater abundance in practice, than tasks associated with the strategic planning function. This is clearly reflected in the development of information technology in planning practice to which we will now turn.

INFORMATION TECHNOLOGY IN PLANNING PRACTICE

We will take three approaches to discussing the development of information technology in practice, which in terms of the previous discussion are each more pragmatic. First, we can explore the development of information systems and consider how far these systems extend into the day-to-day monitoring function on the one hand, and strategic planning functions on the other. Second, we can approach the question of information from the point of view of developments in analysis, forecasting, and design which in some contexts clearly predominate. And, third, we can simply deal with *ad hoc* developments, mainly concerning the efficient input and output of information, mapping, and expert systems in development control and site selection, and suchlike. We will treat these in turn.

It is possible to define a continuum of information systems from the most specific to the most general. The most specific are those such as development control systems which are purpose-built at one extreme, and range to general-purpose software at the other. Systems exist which involve proprietary software with dedicated hardware -- so-called turnkey systems, designed primarily to mirror some standard interpretation of a "typical" local authority's development control function. In contrast, word processing packages and spreadsheets have been used for similar purposes, and often with the same effect.24/ These planning information systems have proliferated in Britain in the last five years. In the only authoritative survey of British planning practice and the development of information technology, Bardon, Stothers, and Elliott25/ show that 49 per cent of all local planning authorities (there are 503 in all) have adopted some form of information technology in dealing with and monitoring planning applications, and of these authorities, most had developed some form of development control information system. This was by far the largest single use of information technology in British planning practice, but the concern with such systems is predominantly in day-to-day routines involving counting, sorting, and prompting the system into efficient response. There is almost a total absence of using such systems for strategic planning functions, and rarely is there any spatial mapping function attached to such systems, although here, progress is likely to be somewhat faster in the next decade.

Information systems for strategic planning hardly exist in any case, despite the work, some fifteen years ago, by the Department of the Environment on a General Information System for Planning (GISP), and by Leeds City Council and International Computers, Limited (ICL) on a Local Authority Management Information System (LAMIS). These systems were ahead of their time in that the appropriate technology did not exist, but by the time such systems were feasible, the strategic planning function had become less important in planning practice. Geographical information systems are largely concerned with physical problems *per se* and are less generally suited to urban and regional planning. There is widespread use of such systems in the United States, but mainly by government and other agencies dealing with land-based resource problems and detailed physical design.26/ Systems such as ARC/INFO have some potential for strategic urban planning, but generally contain a range of functions more suited to detailed physical articulations of problems and the spatial analysis of data. Such systems are, however, developing in more specific contexts and it is likely that some of the components of GIS will find their way into planning information systems in the next decade. However, such systems are more suited for utilities, environmental resource, and suchlike agencies than for physical planning. In fact, only 7 per cent of local planning authorities have developed land and property registers in terms of computer information systems, and it is in this area rather than in GIS, that developments are likely to occur in the immediate future.

There is little evidence of any strong integrating function being developed in British planning practice through the use of planning information systems, and in the occasional case where systems are being considered which are authority and function-wide, the impetus for their development is through hardware and network developments. As already mentioned, such centralizing initiatives are largely absent and where attempted, as in the case of LAMIS, were unsuccessful. More successful developments are based on a bottom-up approach in which elements of information systems are being constructed in a trial and error fashion. This does, however, mean that robust software is being developed and that small-scale, not large-scale information technology is slowly but surely permeating planning practice. This is a clear conclusion of the Bardon, Stothers, and Elliott27/ survey.

Examining the development of information technology in analysis, forecasting, and design, the picture is quite different. There is nothing like the impact occurring here, which is evident in the development control function. Where such activities are being automated, the examples are techniques-led, based on more sophisticated programming of the traditional kind. This area represents the longest established area of computer use in planning, but its importance has declined for ideological reasons as much as anything. In transportation planning, work is continuing using micro-based modeling, but these areas are mainly dominated by consultants developing and marketing modeling software. There is quite a vibrant growth of model-based analysis packages which are being developed in the commercial sector for purposes of marketing, and some of these packages are being used in planning, usually for the analysis of individual initiatives and specific problems which fall outside of the main plan preparation cycle and development control functions.

Perhaps the other largest area of information technology in planning relates to interfacing techniques and data analysis of the information itself. Spatial data input for computer mapping is still laborious, although digitizing technology has improved. Scanning and sensing methods are in their infancy at present. They are likely to make some impact once they become cheaper and more generally available, but the evidence is that where extremely good software exists for input and output, such developments are quickly embraced. For example, the analysis of population census data using Small Area Statistics Package (SASPAC) and its mapping using GIMMS has been dramatically successful in practice where the power of such well-resourced and high quality software has become readily apparent. More elaborate methods of interfacing information systems and mapping packages using ideas from expert systems are on the horizon, but, as yet, such ideas are only in the form of demonstration projects. Nevertheless, the development of rule-based software designed to utilize expert knowledge as well as advise end-users could have major effects in areas such as graphics mapping and development control. For example, Cullen's28/ site development system, Leary and Rodriguez-Bachiller's29/ system for development control, and the whole range of design applications reported in Sharpe30/ herald important possibilities which are very practically based.

It would be possible to develop a more detailed and idealized set of applications of information technology reflecting the need to integrate across a range of tasks within a suitable organization, but the prevailing picture of information technology usage in planning is far from this. As yet, there is little emphasis on using information technology to integrate functions and the dichotomy we have already noted between the fairly widespread but low-level usage of such technology in day-to-day functions such as development control and its almost complete absence from strategic planning, is very marked. Much of what is happening depends upon local conditions, the availability of hardware, and skills, set against a background of increasing cost-effectiveness. Local government usage of information technology is still dominated by the management information systems image where computer functions are centralized and there is more emphasis on mainframe applications than on micros. For example, of the 66 per cent of planning authorities who use computers in Britain, some 36 per cent use mainframe machines exclusively, while 22 per cent just use micros. This picture is changing rapidly, but much depends upon financial constraints and authority-wide procurement policies.

With respect to the types of software being used, table 13.1 reproduced from Bardon, Stothers, and Elliott's31/ survey, provides a rank-ordered list of the most frequently used software, with some indication of the division between in-house development and bought software. This table reflects the comments already made. There is a mix of functions contained in the software listed covering administrative as well as technical areas, and the obvious emphasis on routine control procedures, survey and, to a lesser extent, graphic output, reinforces the fact that information technology is nowhere being used to integrate several related functions. The absence of any mention of fully-fledged information systems development indicates that this new technology is not being used to organize the strategic functions of the typical British planning authority. It is rather difficult to generalize much further, apart from noting the very low levels of use of information technology in forecasting; and this table is complicated by the nonexclusivity of the categories, in that some standard software such as spreadsheets could have been used in, say population forecasting, and suchlike.

TABLE 13.1. TYPICAL SOFTWARE USAGE BY BRITISH LOCAL PLANNING AUTHORITIES

Type of Software	Usage by Local Planning Authorities*			
	Per Cent	Number	Bought	In-House
Decision Analysis	49	244	106	159
Word Processing	37	187	187	-
DC Systems	36	179	117	67
Census Analysis	32	161	156	15
Data Base Management	31	155	152	10
Statistical Analysis	17	84	84	5
Monitoring	16	81	3	78
Computer Mapping	14	71	66	18
Population Forecasting	12	63	14	54
Spreadsheets	11	54	54	-
Employment Survey	8	42	2	40
Property Information	7	37	22	17
Population Survey	7	35	4	31
Building Regulations	6	29	12	17
Housing Forecasting	5	27	1	26
Industrial Survey	5	25	-	25

Source: K. S. Bardon, N. Stothers, and C. J. Elliott, *Directory of Computer Applications in Local Planning Departments* (Birmingham, UK: Computer Applications Research Group, Birmingham Polytechnic, 1984).

Notes: The total number of British Local Planning Authorities is 503. *Bought software and software developed in-house are not mutually exclusive with respect to any local planning authority, and thus the sum of the last two columns can exceed the middle column of the table.

With respect to the need for skills in developing software, table 13.1 shows that standard software such as spreadsheets and word processing are invariably bought, as indeed is more specific but widely available software such as census analysis based on the well-established SASPAC. In contrast, software which takes a role in more strategic planning such as population forecasting and survey analysis are largely developed in-house, at least until well-developed packages become available. With respect to decision analysis, development control, and other such routine functions, much has been developed in-house but as the systems get more elaborate, there is a drift towards bought software. It is clear, however, that skills in information technology more than just the ability to manipulate standard spreadsheet and data base management packages will continue to be required in some measure in the foreseeable future and training must clearly reflect this.

It is also clear that little software exists which might integrate common functions between different areas of the public authority. For example, there do not appear to be systems used by education, health, utility as well as planning agencies, all requiring a common resource. There are major advantages to such integration, but it requires a strategic management focus before it is possible. In fact, it is more likely to emerge in the procurement of common hardware rather than software, due to central purchasing and the increasing development of multiuser systems both in the micro as well as the mainframe environment. Yet, it is even more difficult to generalize in relation to hardware because of the rapid fall in cost and rapid expansion of memory. If anything, the rather low-key picture of information technology use painted above is as much conditioned by the unevenness of hardware development, as it is by any positive or negative strategies concerning the suitability of various software for the range of planning tasks.

Nevertheless, in moving towards education and training issues, it is necessary to attempt to impose some order on the development and use of information technology in planning. It is possible to construe a continuum of software types which can be conveniently divided into general-purpose to more specific, task-orientated software uses. We can identify at one extreme, general-purpose software such as spreadsheets, data base management systems, and possibly statistical analysis packages, although within this category there are clear differences implied in skill levels needed to operate the software. A second, intermediate category involves small system, task-specific software such as cartographic and mapping, forecasting, and possibly small-scale development control systems. The last category would be large system, task-specific software such as geographical information systems, fully-fledged modeling and analysis packages, and suchlike. These three categories would imply quite marked variation in usage with very large numbers of individual users involved in general-purpose software and very small numbers in the most specific software category.

A second continuum involves the particular role of the software user. Again, we can define three distinct levels with respect to these roles within planning. There is the end-user, as defined by Manheim[32] as a manager or policymaker involved in strategic issues but requiring access to software in various contexts. The second category involves the traditional technical professional, the middle-level planner involved in operating the planning process or tasks within it, in either a strategic or more routine environment. Lastly, there is the analyst involved in highly technical and scientific tasks which involve deeper computing skills, such as systems analysis and programming. There is some correlation with the three categories of software, end-users using general-purpose software, and analysts using large-scale task-specific software, but increasingly roles and software types are being mixed in any particular task. At this point, we can begin to anticipate the problem of training which will emerge in this paper. The training of end-users in general-purpose software use, although necessary, is nonproblematic for increasingly such software is designed to be self-training. Training analysts at the other end of the spectrum again is obvious in that formal computer courses are required. The problem really lies in the middle ground, in training technical professionals to interact with a variety of software and to creatively begin to use and integrate it relative to their professional expertise. We will return to this in a later section, for it marks the most important training and education problem faced not only by planners but in many other professional contexts.

We cannot be as specific about the diversity and appropriateness of hardware to the planning task environment, for increasingly major tasks can be developed on small machines. Software developed on one type of machine can be ported to others, and the appropriateness of different forms of general-purpose hardware is a particularly uncertain decision area. Specific hardware is easier to identify, in mapping and graphics for example, and it is clear that decisions about more general-purpose functions and whether or not mainframes, minis, or micros are more or less appropriate depend more on financial and other resource and political constraints, rather than on technical-professional issues. When it comes to "orgware," even less is known about appropriate systems and it is also clear that as much training related to the type of task environment and how it can be reorganized to cope with information technology is required, as is training in the uses and design of that information technology *per se*.

THE TRANSITION TO POSTINDUSTRIAL PLANNING

We must digress slightly, at this point, to describe how technological change is converging with ideological change in the late 20th century, and how this convergence is changing the nature of planning itself, notwithstanding the introduction of information technology into the task environment. We have already alluded, in the introduction, to the origins and impact of technological change which, in essence, is leading to massive automation of existing functions in everyday life, as well as new creative opportunities using information and ideas in the context of computing. Accompanying these changes, and perhaps because of them, values towards the role of individual action and decision in modern society are changing. In short, the primacy of the individual and self-interest in contrast to the public interest is being emphasized, and combined with some widespread dissatisfaction with the role of government in Western societies, such collective issues as planning are under considerable scrutiny. Thus, technological change is creating opportunities for indulging greater individual interest and this, in turn, is creating a new attitude towards the role of the state.

There are many views of this symbiosis of technological and ideological change. Barrett and Leather33/ say: "... the thrust for IT development can be seen as a response to restructuring problems facing a 'postindustrial' capitalist economy, for survival within the world economy." Equally, it could be argued that new technology is not a response but a fundamental force causing such restructuring. In essence, the implication is that such changes cannot be separated, and that such changes constitute a much more heterogeneous and volatile context for training and education in information technology, than was assumed in earlier discussions of this phenomena, at Kawasaki City, for example, in the first international seminar held in 1984.34/

The idealized model of the planning process which has so far in this discussion provided the implicit benchmark for training and education, and is illustrated in figures 55 to 57, is dramatically changing as it is being adapted to an ever heterogeneous, confused, and turbulent practice. The belief in a single collective rationality pursuable in a comprehensive, all-embracing manner, is no longer important, if only because such rationality is not achievable in this form. Indeed, as the role shifts more to individual action, this model is being increasingly used competitively by several conflicting interests, thus emphasizing the need to conceive of planning as a process of reconciling interests rather than as one of defining and reaching a uniform, homogeneous end-state embodied in the form of a blueprint plan. The strategic focus of planning is thus becoming less significant.

Urban problems are no longer articulated in simple, comprehensive terms. Many agencies each have an interest, their responsibilities cutting across one another, and new areas of commonality are becoming important. New agencies are being defined for new problems which emerge in a "political" rather than "rational" fashion. The notions that the planning process must represent complete cycles of observing, analysing, designing, deciding, and acting, and that there may be "correct" starting points in the planning process have largely been abandoned. Thus the fact that many different planning processes compete within the planning environment has introduced a level of volatility and diversity into planning that makes it difficult to generalize about the use of information technology, even in theory, and makes any quest towards using such technology to integrate functions, as indicated in figure 57, highly problematic. This, of course, is the picture borne out by the discussion of practice in the last section.

We must not digress too much, but it is worth making this volatility more apparent because much of the uncertainty being generated is directly due to new concepts of information and decision, as well as new technology. Information is clearly becoming a major product or good in all societies. It is no longer regarded as being free, if ever it was, but it is now tradeable explicitly, in new forms of marketplace. Value is added to it or taken from it as it is processed, the ultimate product and access to it reflecting the various forces and agencies which have moulded it. Access to information is becoming an all important issue and a new social differentiation between information-rich and -poor is becoming significant from school age onwards.35/ The proliferation of hardware is having both decentralizing and integrating -- decentegrating as we have coined the term here -- influences on cities, spatially and in terms of socioeconomic and temporal organization. Rapid advances as in the network city, the network planning agency, and the network university as we will see in the next section, are characteristic impacts of this technological change.

The decentralizing effects of computers and their miniaturization are clearly reinforcing the growth of individual interests and are speeding up the breakup of big government, in one sense at least, through privatization. Planning in its comprehensive, mid-20th century form, is being disbanded, being replaced by the multiagency, multi-initiative area-based approaches to investment, negotiation, and political action. This is a very dramatic force in Western societies at present, and it is being reinforced by the use of information technology for simple routine monitoring rather than for strategic planning. In developing countries, such forces are clearly at work, but working in more global, aggregate terms, and here, as in the West, ideological change is being fostered and aided by technological change.

The surprising thing about these changes is that they have been only dimly anticipated at best, and simply unanticipated at worst. Perhaps the most dramatic example of this is the quote from Donald Michie,36/ a leading expert in artificial intelligence in Britain, who writing in 1968 said: "For many years, only the rich will be able to install terminals in their private houses ...." This sentiment which was widely held until the late 1970s puts the rate of technological change and its many surprising and novel features in perspective. Several unusual and even "shocking" characteristics are part of the present picture. The emergence of new roles of computer user -- in particular the end-user of general-purpose software -- and the emergence of a multitude of software products, so proliferating that it is difficult to find any clear advice on their appropriateness, were never anticipated in any fashion. In particular, the emergence of spreadsheet type programmes and data base management systems heralds an era of software specifically spinning off from computer development and availability, rather than from the implementation of traditional and prespecified techniques and methods. Manheim's37/ third computer revolution with its emphasis on the end-user and decision support systems is one image of this.

Qualitative computing, again seen best in spreadsheet, word processing-like software, was also largely unanticipated as evidenced in the almost exclusive concentration in computing on numerical computation until ten years or so ago when graphics, voice, text, and other forms of data processing began to emerge significantly. Another feature of computing involves its enhancement through interfacing with conventional man-machine systems. The development of expert systems which use computation to elicit rational and expert dialogue does not depend on formal models of design or decision, but on using the power of the computer to prompt, correct, and remind already expert users about appropriate strategies in applying their expertise to relevant problems.

The idea that information technology involves less direct cost or outlay is also being rapidly dispelled. There may be the occasional situations where machines replace labour and costs are thus cut, but in general, costs increase although unit cost in production can fall dramatically. Information technology provides much greater opportunities for designing and producing better products and services, but the capital involved in doing so and the labour intensity of the initial software design are very great. Computer mapping may be as labour intensive as hand-drawn mapping, but the potential for producing much higher quality maps, their transmission, the way they can be stored, the way they can be integrated with other digital data and suchlike, all emerge from the technology. Digital maps are as hard to originally produce as any other forms of map, but, once computerized, can be subject to almost infinite variation. Such variation leads to the creation of a marketplace for such software products, and this enables extremely sophisticated user-orientated design of such products to be enabled.

But it is the speed of change which is the most daunting. Moskovitz and Mammen38/ argue that: "Staying abreast of technological developments is a full-time job," while the same problem exists with respect to software. Continuous miniaturization and specialization of hardware, the proliferation of information services and opportunities through networking, as well as the proliferation of software with an increasingly high ratio of software designers to end-users, especially in the planning field, all combine to make the present period of transition one of great culture shock. Conditions vary, of course, between the developed and developing world, and different types of training are required, but the shock of transition is equally great in whatever world one exists.

These points can be quickly demonstrated with respect to current changes in hardware, software, and "orgware." Miniaturization and the proliferation of small computers have occurred at the same time in developed and developing countries, and in both contexts, new end-users have appeared. Networking presents a bewildering array of new choices to users and designers wherever such possibilities occur. In developing countries, there is often no prior exposure to computers before many systems are introduced together, but this is little different from developed countries, where new, nontraditional users have provided the rapid expansion in computer use occasioned by miniaturization and networking. Software products, especially high-level general-purpose software like spreadsheets, are continually changing and new familiarization is forever required. Training in such tasks may be easier in developed countries, but the "newness" of the tasks is the same wherever such software is introduced. Special-purpose software, such as geographical information systems, requires very detailed training and is especially rich in content. Differences in capital finance available, general educational attainment, and organizational structures may suggest differences in training between developed and developing countries, but, in general, the type of training is likely to be similar; it is the context and ability to ensure such training takes place and is useful in practice that mark the differences.

So far, there has been little thought given to appropriate "orgware" for information technology, although progress towards the electronic office and cottage appear much slower than was originally anticipated for practical rather than technical reasons. The organization of new technology is difficult as it has the potential to break existing habits quite radically, but the technology -- hardware and software -- can date very quickly leading to financial difficulties in replacement, loss of skill through obsolete software, and changing expectations. All this, combined with a volatile and changing task environment, makes definite recommendations for education and training difficult, especially with respect to task-specific software. Training or rather raising awareness in end-users or in analysts is fairly easy to prescribe for, but training for technical professionals will always be tricky. Specific hardware and software products can take up much time with respect to skilled learning, and, as yet, it is not clear how transferable such learned routine behaviour is. Thus, in one sense, the rather gradual introduction of information technology into routine rather than strategic planning functions is a more robust strategy in that a reasonably sound if low-level base is being built up.

There is also a generation problem involving information technology training. At the awareness level, the need to inculcate things like keyboard skills and basic computer literacy should be short-lived, as individuals emerge who have acquired such skills as a matter of course in the information society. A small problem may always remain to be addressed, but, in general, awareness-like training will become less necessary. The real problem lies in acquiring a skill base, more than enough to be able to load and operate a spreadsheet or word processing package. For example, even to send electronic mail at present, it is necessary to be familiar with an operating system, and although this is a routine task, it is never as straightforward as it might appear. To engage in on-line bibliographic search, or to be able to creatively merge and integrate general-purpose software modules to pursue some more complicated planning task, does require a lot of exposure to such packages and their manipulation. Some general-purpose software should be picked up by users with special training, but training in special-purpose software such as SASPAC or MINITAB (a statistics package) is in itself only suitable for specialized professional users.

The emphasis in training then should be based on ensuring that some skills which are imparted do survive technology and software change. Training in particular packages should probably be provided (and usually is) by those who have designed and/or market the product. There is, of course, a risk in acquiring any such software, especially that linked to hardware, and it is necessary to spend much time thinking through the issues raised here before embarking on purchase and major training, which could be obsolete in a matter of years. The need for advice centres which help resolve such uncertainties should be a major component of the introduction of information technology into most social contexts, planning in particular. At this point, we will begin to recount some examples drawn from our own experience in an academic context involving the way education and training can have, and should evolve with respect to the introduction and use of new information technology.

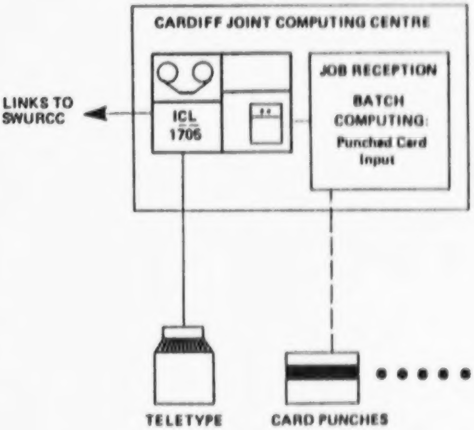
HARDWARE SHOCK

The sheer volume of computer equipment, the ability to access it through networks, and the need to continually learn how to use new operating systems, all combine to produce extremely labour-intensive activity in the development and use of information technology. This cannot be emphasized too much. Users can easily find themselves spending all their working time interacting with the new technology because the opportunities presently available are so great and because no stable limits have yet emerged with respect to the use of such technology. The best way to illustrate the shock which is induced by the development of new hardware is with respect to my own department and university, where there has, like many others, been dramatic development in hardware over the last seven years.

In British universities in the 1960s and 1970s, the computer centre was a highly centralized unit, maintaining usually one, but sometimes two or more coupled mainframe machines, and operating a batch processing service with some advisory programming support. Most programmes were entered on punched cards or occasionally punched tape with a turn-around of jobs usually once or at most twice a day. Sometimes for shorter, educationally-orientated teaching jobs, a cafeteria system was operated in which users loaded their own jobs and collected their own output from printers under the supervision of an operator. However, the general system meant that the user was remotely stationed with respect to the computer and that noninteractive processing was the order of the day. By the mid-1970s, terminals were making their appearance, thus facilitating some interactive use. Teletypes were more usual than VDUs, but by the late 1970s, VDUs were beginning to replace all modes of input.

In mid-1979, computing in Cardiff was organized between the two university colleges, as a joint service based around an ICL mainframe with some interactive lines to teletype terminals. In the Department of Town Planning, one teletype machine was available, but most work was submitted using batch processing, on cards, and much work was done at the Computer Centre itself rather than in the Department. Most of the emphasis in teaching and research was upon statistical and forecasting techniques. There was little emphasis on graphics or information systems, and in Manheim's39/ terms, the situation which is depicted in figure 58 represents computing as it was organized during the first and second computer revolutions based on transactions processing and management information. Most of the activity in planning involved numerical work.

Figure 58. Hardware in the Department of Town Planning, UWIST, in mid-1979



In late 1979, the College acquired two VAX minicomputers to replace the mainframe installation. One of these machines was dedicated to research, the other to teaching, each supporting up to ninety-six users. Users were scattered over central Cardiff, being linked interactively with the machine over public telephone lines. Four lines were available in the Department, two to VDUs, two to lineprinters/teletypes. No campus network then existed, so terminal lines were reserved either for research or teaching. The picture is illustrated in figure 59 and it implies the beginnings of some specialization. A teaching classroom had become available centrally for the College, microcomputers had been acquired heralding the move into graphics on the one hand and text processing on the other, and some emergent networking possibilities were being discussed. The period 1980-81 saw the total demise of punched cards, again entirely unanticipated by the general user.

The next main development came in 1983, when a campus package switching exchange was developed. By this time, additional VAX computers, for research and teaching, for CAD, and for development had been added, and the need to access any one of these from each terminal had become well-established. Moreover, in Britain, the micro-revolution was in full flight and the dual use of micros for mainframe terminals and vice versa was being widely canvassed. Figure 60 illustrates the situation in the Department of Town Planning in the summer of 1983, with machines acting as terminals to the VAX computers, a separate micro classroom, and a network of micros used for word processing also having been established. The notion of linking any of these machines together was by then the common procedure used in transferring software between machines for different types of processing. During this period, considerable experience was being gained in graphics at the micro level, and general experience in microcomputing was also used in being able to advise on the secretarial word processing facility which was set up at this time.

Figure 59. Hardware in mid-1980

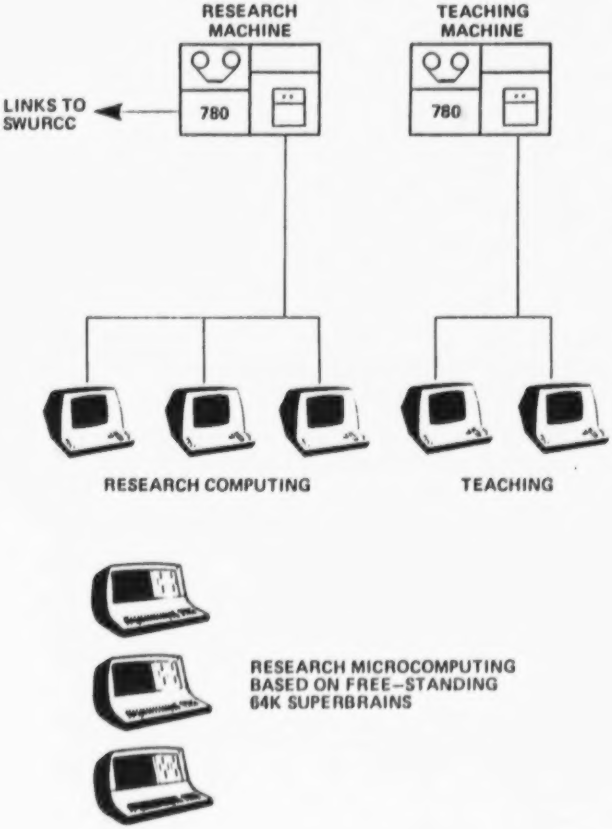
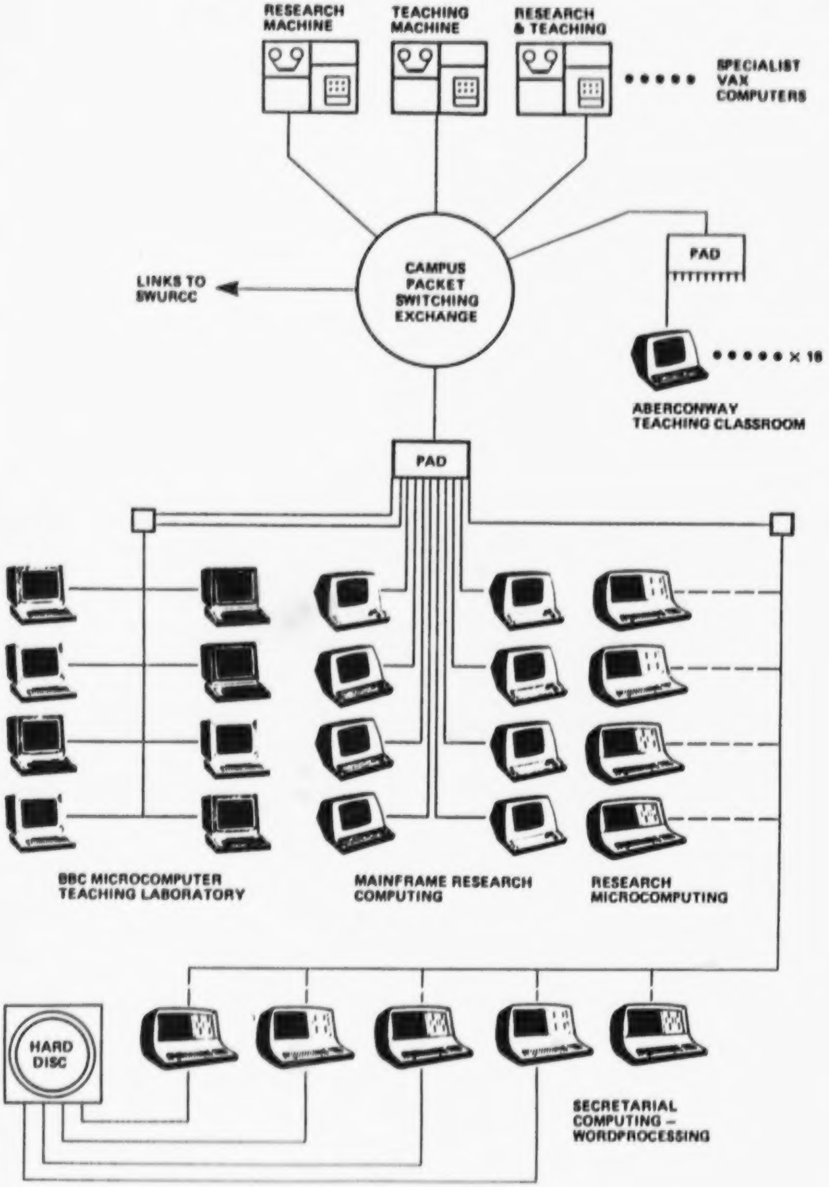

RESEARCH MACHINE
TEACHING MACHINE
LINKS TO SWURCC
780
780
RESEARCH COMPUTING
TEACHING
RESEARCH MICROCOMPUTING BASED ON FREE-STANDING 64K SUPERBRAINS

Figure 60. Hardware in the Department of Town Planning, UWIST, in mid-1983


RESEARCH MACHINE
TEACHING MACHINE
RESEARCH & TEACHING
SPECIALIST VAX COMPUTERS
CAMPUS PACKET SWITCHING EXCHANGE
LINKS TO SWURCC
PAD
× 16
ABERCONWAY TEACHING CLASSROOM
PAD
BBC MICROCOMPUTER TEACHING LABORATORY
MAINFRAME RESEARCH COMPUTING
RESEARCH MICROCOMPUTING
HARD DISC
SECRETARIAL COMPUTING – WORDPROCESSING

The last stage in the evolution of the present infrastructure began in mid-1984, with the establishment of the local area network based on rings linked to the central switching exchange. Attached to the network are a whole variety of devices, mainly VAXs and MicroVAXs, but printers, terminals, and suchlike peripherals all connected via pads. Considerable specialization now exists and each teaching department has its own terminal classroom supported by one of the MicroVAXs. The situation in the Department of Town Planning is shown in figure 61, where it is clear that considerable specialization has occurred relative to the situation shown in figure 60. The teaching classroom doubles as a microcomputer laboratory, while research graphics and cartography, microcomputing teaching, general-purpose statistical computing, and word processing for staff and secretarial use have all emerged as distinct functional areas. Within microcomputing, there is further specialization with BBC micros being used as VAX terminals and graphics devices, IBM-PCs or clones being used to support standard general-purpose software, such as spreadsheets and word processing.

Comparison of figure 58 with figure 61 illustrates the change which has occurred in a matter of five or six years. The future will clearly be much closer to figure 61 than the past was, and thus this period makes a profound discontinuity in the development and proliferation of information technology hardware. It is difficult to portray the differences which the new technology brings, but the ability to network computers dramatically increases the type of processing and information available to any single user. Figure 62 illustrates the network of computers available to fifteen teaching departments for some 2,500 students in my own university. Even at the time of writing, two additional MicroVAXs are being purchased as well as a host of new workstations all to be attached to the network.

In one sense, the opportunities now available have not yet been absorbed or appreciated by the vast majority of users. For example, a whole range of information services ranging from help and advisory facilities in programming to on-line bibliographic library search, and electronic mail now exist, but only a small fraction of users are cognizant of this. Phone facilities, job transfer between users and machines, mail to other universities using the Joint Academic Network (JANET), and the abilityto access data banks such as census data now all exist, but learning how to access them and how to use the associated software is an extremely labour-intensive activity. We will return to this point in the next section when we examine the range of software now available, but it is clear that a major task in the immediate future will be devising the appropriate organization -- "orgware" -- which will enable the potential of this technology to be fully realized. This is most apparent in areas of routine information

Figure 61. The Present (mid-1987) Configuration of Hardware in the Department of Town Planning, UWIST

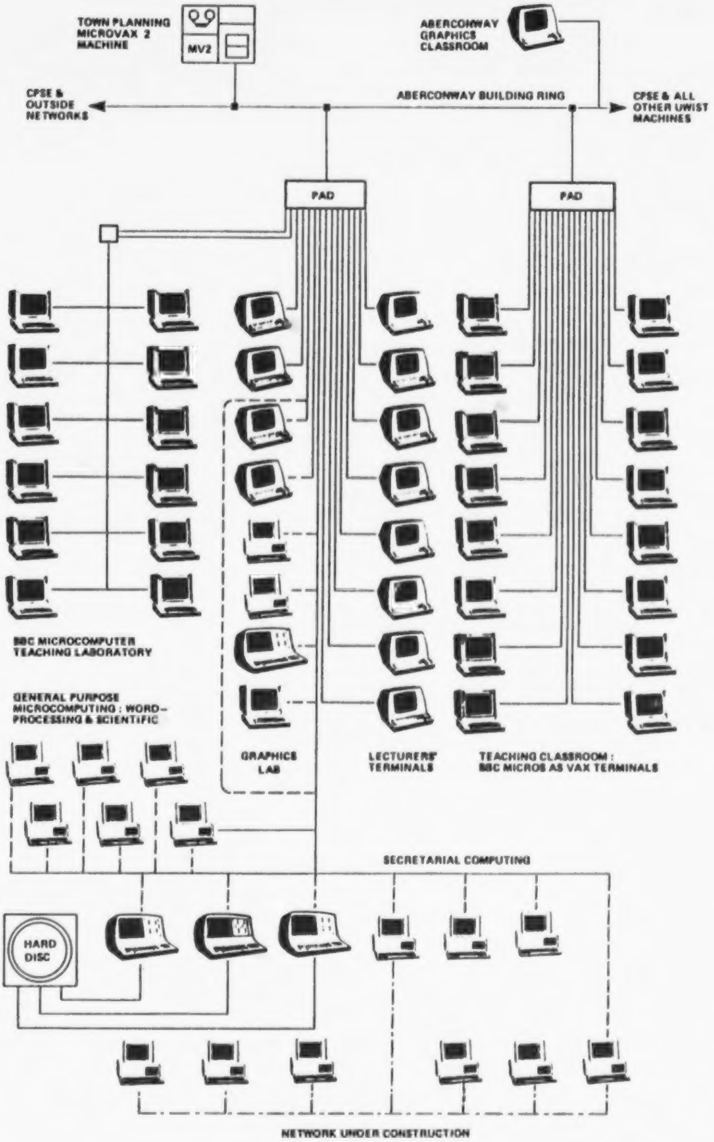
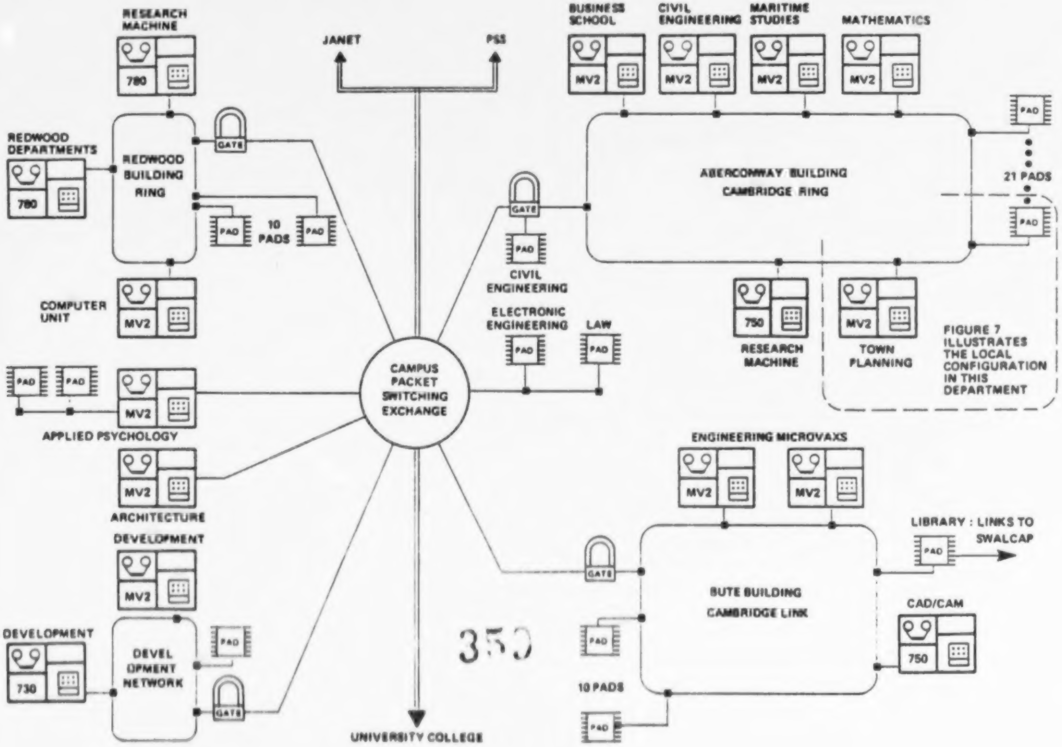

TOWN PLANNING MICROVAX 2 MACHINE
MV2
ABERCONWAY GRAPHICS CLASSROOM
CPSE & OUTSIDE NETWORKS
ABERCONWAY BUILDING RING
CPSE & ALL OTHER UWIST MACHINES
PAD
PAD
BBC MICROCOMPUTER TEACHING LABORATORY
GENERAL PURPOSE MICROCOMPUTING : WORD-PROCESSING & SCIENTIFIC
GRAPHICS LAB
LECTURERS' TERMINALS
TEACHING CLASSROOM : BBC MICROS AS VAX TERMINALS
SECRETARIAL COMPUTING
HARD DISC
NETWORK UNDER CONSTRUCTION

Figure 62. Information Technology and the Local Area Network in UWIST mid-1987


RESEARCH MACHINE
780
JANET
PSS
BUSINESS SCHOOL
CIVIL ENGINEERING
MARITIME STUDIES
MATHEMATICS
MV2
MV2
MV2
MV2
PAD
REDWOOD DEPARTMENTS
780
REDWOOD BUILDING RING
GATE
10 PADS
PAD
PAD
GATE
ABERCONWAY BUILDING CAMBRIDGE RING
21 PADS
PAD
PAD
CIVIL ENGINEERING
COMPUTER UNIT
MV2
750
RESEARCH MACHINE
MV2
TOWN PLANNING
FIGURE 7 ILLUSTRATES THE LOCAL CONFIGURATION IN THIS DEPARTMENT
ELECTRONIC ENGINEERING
PAD
LAW
PAD
PAD
PAD
MV2
APPLIED PSYCHOLOGY
CAMPUS PACKET SWITCHING EXCHANGE
ENGINEERING MICROVAXS
MV2
MV2
MV2
ARCHITECTURE
DEVELOPMENT
MV2
LIBRARY : LINKS TO SWALCAP
PAD
GATE
BUTE BUILDING CAMBRIDGE LINK
DEVELOPMENT
730
DEVELOPMENT NETWORK
PAD
GATE
PAD
10 PADS
PAD
CAD/CAM
750
UNIVERSITY COLLEGE

processing, where most of the technology remains unexploited and where secretarial use of the technology is mainly for typing rather than information management and filing.

To imply that there is deep culture shock in the introduction of information technology requires some elaboration. There is clear shock involved in the introduction of new hardware and software, but this is soon rationalized as users adapt by learning or by shutting out new opportunities. But with so much new hardware in the marketplace, and so much interchangeability between these products, those involved in deciding on new hardware do face major uncertainties. After being involved in computing as an end-user and high-level programmer since the mid-1960s, I still find it difficult to decide on new technology, short of sitting down and conducting my own intensive evaluation which might take many days. Advice and training in this area is almost nonexistent, but it is essential if better decision making about such technology is to be invoked.

There is an urgent need for limits to be set on the type of education and training relevant for different types of planners in different roles. At present, most of our students are introduced to computing in a formal structured fashion, rather than being exposed to the infrastructure more casually. The sort of computer use which characterizes engineering students is not a feature of planning education, but there is a lot to be said for introducing planning students to general-purpose software, networking opportunities, and even games, at a very early stage. This clearly increases awareness, but it also provides the right style of environment to enable technical professionals who comprise the planning students being trained, to engage in the kinds of interactive computing which is increasingly necessary to synthesizing diverse but standard software relevant to a variety of planning tasks. Moreover, the need to train planners to use a range of information services can be easily developed in the sorts of computing environment pictured in figures 61 and 62, simply by exposing students to mail, phone, and bibliographic services.

Hardware shock -- compare figures 58 and 61 -- can be considerable, but if there is no tradition of information processing, it can be daunting. For example, in some developing countries, the gradual evolution of computer systems is not a feature of the evolution of information technology. Suddenly, technology equivalent to that displayed in figures 59 or 60 comes on stream where none had existed before. For example, a joint project between UWIST and the University of Technology Malaysia (UTM) sponsored by the British Council, involved developing an applications software package of standard planning techniques along the lines of the UDMS40/ software. This was originally developed for an IBM-PC environment using a portable COMPAQ micro which was transported to and from Malaysia for the project.41/ The Planning School at UTM did not have access to any micros in 1986, but by mid-1987 an elaborate laboratory consisting of ten IBM-PCs had been established, fully provided with all the standard software -- LOTUS 1-2-3, dBASE III, etc. -- required to operate the applications software. From a situation of nothing, a picture akin to figure 60 emerged overnight and all the problems of rapid training of staff, then students, to make best use of the technology have suddenly occurred. A similar situation could well exist at the Institute of Technology, MARA, in Kuala Lumpur, where another UWIST project with the Transport Centre presently depends on the availability of only one micro. Any sudden change of the kind occurring at UTM could transform this project and open up possibilities not considered hitherto. Yet if hardware shock of the kind described here can be daunting, software shock -- the existence of new forms of software for which there is no prior expertise -- can be even more dramatic. To this, we will now turn.

SOFTWARE SHOCK

Models of the emergent decentralized or decentegrated information technology hardware illustrated in figures 61 and 62, do enable some clarity and understanding of what is likely to be the norm in the medium-term future, to be gained. In contrast, there are no such models of the organization of software in general, and certainly none in specific task-orientated fields, such as planning. In some senses, the development of software is much more diverse than that of hardware, largely because hardware is general-purpose, software is invariably specific, at least in its application. Traditional software, such as that operating on mainframe machines, a decade or more ago, of which much survives in a more modern form, depends largely on the field of application, and often on its frequency of use. For example, development control systems although based on information systems principles are specific to routine planning tasks, while the whole range of forecasting, modeling, design, and graphics presentation and cartographic methods are specifically orientated towards narrow and easily definable functions.

New tasks, however, have emerged. General-purpose software, which can be applied innovatively to a whole range of new and traditional tasks are being extensively developed, particularly in a micro-computing/end-user context. Much of this software is business management-orientated based on various forms of accounting systems, but a variety of new tools -- spreadsheets, data base management systems, text processing packages, even micro-based presentational-draughting-publishing packages -- are now

361

available. These systems appear to be applicable in many contexts, and a creative synthesis of such software in pipeline processing form would appear to open up their application to many more specialized tasks. It is tempting, given the pace of such development, to see whole fields such as planning, to be ultimately composed of end-users and systems development programmers. However, although some of these potential applications are likely to be useful, many can only be approximated by such general-purpose software and although useful pedagogically, can never replace purpose-built software. We will return to this point later by way of examples.

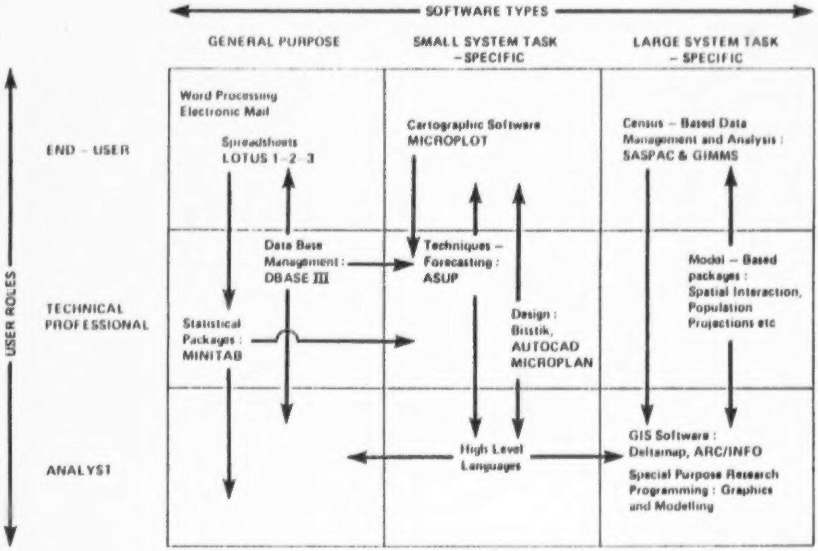
One change which is a consequence of the increasing significance of general-purpose software, is that designers of software are no longer users; end-users now represent a whole class of new users of high-level sophisticated technical applications software. But in planning, this change has not and is unlikely to have a major effect. In figure 57, for example, most of the channels where information technology serves to integrate planning functions -- in information system design itself, in forecasting, design, and analysis, and in expert systems interfaces, graphics, and input processes, fairly specialized software is required despite the increased use of general-purpose packages at various stages. In fact, it is useful to look at the type of software required in a variety of these planning tasks, with respect to the model of software types and user roles elaborated in an earlier section. We defined three types of software -- general-purpose, small task-specific, and large task-specific, and three kinds of users -- the new non- or atechnical end-user, the technical professional, and the analyst -- of which the end-user essentially represented use of software in a management-policy role, the technical professional, a strategic but problem-solving role, and the analyst, a high-level programming or even systems development role.

We can define such software types further in terms of typical software items available to staff and students in my own academic environment. General-purpose software can be further subdivided into that which is entirely common sense-orientated such as word processing, data base management, and spreadsheets (WORDSTAR 2000, dBASE III, and LOTUS 1-2-3/LOTUS Symphony are examples), and that which is more technically founded such as statistical packages (MINITAB and SPSS-X are examples). Small system task-specific software relating to modeling, cartography, and possibly design include examples such as MICROTRIPS -- a package to enable traffic distribution and assignment modeling to be developed, MICROPLOT -- a computer cartography package, and AutoCAD -- a graphic (3-D) design package. Large task-specific software can be just larger versions of the same. SASPAC is an example of an elaborate package used to access small area statistics data at ward and parish level from the Census of Population, ARC/INFO is an elaborate terrain, thematic, and cadastral geographic information system useful in part in a variety of spatial information and mapping contexts.

Software types can be defined more easily than user/developer roles in software applications and design. Here, the same person can act out many roles in different tasks, as well as during the same task. For example, in designing a population projection programme, an individual can act at the analytical level mainly, but in presenting output, may use standard mapping and information data base packages, while frequently requesting high-level help facilities requiring information in an on-line context. It would indeed, in planning, be rare for the technical professional to not also act as end-user and just occasionally as analyst. For example, there are several applications of forecasting, modeling, and evaluation using spreadsheets,42/ but although planners might act as end-users in learning about spreadsheets, they would need to act as technical professionals in coupling spreadsheets and data base management packages together to effect useful applications in forecasting. Indeed, the interfacing may require a more analytical role.

To clarify these points, it is worth examining the software which is available to myself and colleagues in teaching planning students about information technology at UWIST. In figure 63, we have attempted to classify the software in use in the Department of Town Planning, according to the three types and roles defined. The arrows on the charts show the way in which software types and roles can be mixed in developing information technology, with respect to various planning tasks. Although there is a mild correlation between specificity of role and type -- end-users mainly using general-purpose software and analysts using large system task-specific software -- it is not easy to be definitive about the linkages between roles and types. New linkages are being forged all the time. Increasingly, planning teachers are using types of software across the whole range, often within specific tasks and often in entirely different tasks, hence roles. We do not have any specific structure of roles and tasks any student undertakes in our courses, and, indeed, our purchase of the software in figure 63 has been somewhat *ad hoc*. Nevertheless, the burden of our education lies upon training planners in the technical professional role across a range of tasks involving the range of software types. It is the middle line of figure 63 which marks the really essential area of training. Indeed, as the amount of relevant software continues to grow explosively, we can spend all our time available in avoiding analytical teaching and concentrating on technical professional roles, assuming that the end-user role will look after itself. A lot of innovation in training and teaching is possible here. We have hardly broached the questions of how to teach such roles effectively, but already we feel that it would be easy to fill a one-year course entirely devoted to information technology in planning, with training in various forms of packaged software, thus acknowledging the labour intensity of such training. In essence, then, it would appear that training planners as analysts is unlikely to constitute the main priority.43/

Figure 63. Software Types Concatenated with User Roles


SOFTWARE TYPES
GENERAL PURPOSE
SMALL SYSTEM TASK – SPECIFIC
LARGE SYSTEM TASK – SPECIFIC
USER ROLES
END – USER
TECHNICAL PROFESSIONAL
ANALYST
Word Processing
Electronic Mail
Spreadsheets
LOTUS 1–2–3
Cartographic Software
MICROPLOT
Census – Based Data Management and Analysis :
SASPAC & GIMMS
Data Base Management :
DBASE III
Techniques – Forecasting :
ASUP
Model – Based packages :
Spatial Interaction,
Population Projections etc
Statistical Packages :
MINITAB
Design :
Bitstik,
AUTOCAD
MICROPLAN
High Level Languages
GIS Software :
Deltamap, ARC/INFO
Special Purpose Research Programming : Graphics and Modelling

The shock of being exposed to so much diverse software can be overwhelming. Our students are rarely exposed to more than 40 per cent of the software in figure 63, but the time required to become familiar with say, word processing, spreadsheets, data base, cartographic input, census access, spatial interaction modeling, and graphic design packages could easily swamp everything else in a year's course. Great familiarity is required to cultivate the requisite expertise and there is the ever-present problem of software becoming obsolete through new products or at least, new generations of the same product becoming available. The ratio of products to users in planning is very high, but the environment in which such access is possible, is also rich in hardware opportunities. For example, figure 61 indicates that sixty-two workstations (micros and networked terminals) are available to 150 students and twenty faculty in the Department of Town Planning in UWIST. With some twenty or so general-purpose and small task-specific software products now available, no one staff member can become proficient in more than three or four such packages. In fact, attitudes towards this diversity and amount of software are ambivalent. Many feel the pressure to attempt to know them all, but increasingly, choices need to be made about what people specialize in as end-users and technical professionals. The shock of realizing the need to change attitudes towards software use and expertise is slowly sinking us. A real dilemma must be overcome in information overload.

Learning about general-purpose and any other variety of packaged software will be the major training task in all contexts of information technology use in planning, but experts in analysis and programming will still be required to design appropriate software at all levels and to advise the technical professional about possibilities in applications. In fact, no general-purpose software is likely to be as good as more specific one-off designed software until the demand for such software forces designers to define the appropriate market for the package. And in the last analysis, the quality of application will be influenced by the abilities of the professionals and analysts involved. One problem increasingly faced by professionals is in their exploration of the appropriateness of standard software. General evaluations are not easy and often only possible after a high level of training by which time the individual is locked into its use. Combined with the volatility of the organizational and task environment of planning, the ever-changing hardware context, and the traditional constraints of skill and finance, it is hard to generalize about training apart from identifying the common elements required, and the most robust software available.

EXPERIENCES FROM EDUCATION AND TRAINING

It is tempting to use all the ideas introduced in this paper to suggest a programme for education and training in a variety of academic and practice-based contexts. But this assumes we have a clear view of what is required and as we have argued, the current shock of new technology and the volatility in ideas and practice it has and continues to bring, makes a detailed and definitive scheme out of the question. Of course, it is essential for training to be robust and broad-based to withstand the ever-present threat of almost immediate obsolescence and to stress principles, even if conducted in the context of applications.

Rather than synthesize the various themes introduced here, we will simply begin to conclude this paper with some experiences of teaching students and staff from both developed and developing countries in various software packages involving the range from general-purpose to large-scale, task-specific applications.

The background to our education in information technology to planners at UWIST is one of providing a fairly broad-based exposure to information technology in terms of the different hardware illustrated in figure 61, and the various roles and software types indicated earlier. However, the emphasis is mainly on the technical professional and end-user roles. Although some students receive a course in programming, most of the emphasis is on statistical computing using MINITAB, census access using SASPAC, and the computer cartographic package GIMMS, and on demonstrations of modeling software and mapping of local area data. Some micro-based packages involving planning techniques and data base design are also introduced. End-user support is minimal, students being left to their own initiative in developing word processing and spreadsheet applications. Training in CAD (Computer-Aided Design) is minimal, although a good deal of conventional urban design training is offered. In essence, the focus is on learning about standard software rather than on any analytic software design. We have described the courses we offer elsewhere.44/ Here it is appropriate to describe three typical applications involving students from developed and developing countries.

A course entitled Microcomputer Packages is offered to our beginning graduate students, which introduces them to the range of planning techniques involving analysis, forecasting, and modeling using standard general-purpose, graphics-orientated software. This is supplemented by the programmes developed by Ottensmann,45/ and a related project has been based on the UDMS software46/ which covers a similar range of techniques. This software running under CPM on Superbrains was not very successful, being full of bugs and with no graphics capability, and it was decided to develop a tailor-made portable package synthesizing these various software packages for operation in an "IBM-PC" MS-DOS environment. The package was based on four techniques: population projection, employment forecasting, spatial interaction, and site potential analysis, and was organized to display the model workings and results graphically. A simple expert system-like user interface was provided to enable users to access the various techniques from a standard hierarchically-orientated menu system.

The package entitled Applications Software for Urban Planning (ASUP) was developed on a portable COMPAQ machine under MS-DOS, and was supported by a grant from the British Council which enabled its author47/ to develop the package for use in Malaysia at the University of Technology Malaysia in Johor Bahru. An innovative feature of the package was the way the data input was organized using dBASE III which enabled successful input and updating at a high level of end-user access. This was coupled to ASUP and the interactive element of the package was translated into Malay in the winter of 1986-87. In the summer of 1986, when it was developed, the department at UTM had only the portable COMPAQ on which to develop this but by mid-1987, had acquired a network of some ten micros on which the package had been implemented. Indeed, a spur to the acquisition of this information technology was the collaborative arrangement and the existence of this package. Teaching opportunities have not yet been realized in UTM, but an important resource tailored to the local context now exists. Problems still exist in the software, but perhaps the biggest constraint to development is the fact that the graphics interface is still device-dependent.

The second package developed in-house in UWIST is now device-independent in the graphics sense and entirely portable in the IBM-PC (and clone) environment. This package involves a residential location model based on spatial interaction concepts and was originally developed by this author on a VAX 780 in Melbourne University in 1982. The package is entirely graphics-orientated using the PLOT 10 graphics language, and it has been successively ported to the UWIST VAXs with GINO graphics where it has been running for student demonstration since 1983. The model package involves data input, display and exploration, calibration of the gravity model, and predictions, with an emphasis on map display interfaces. The model has been applied to Melbourne, Reading, Barry, Cardiff, and Singapore, which range from eight to about fifty zones. It is used in courses involving urban modeling and originally evolved from such teaching to second-year undergraduate planning students.48/

The model in the VAX FORTRAN form was not very portable but recently, in November 1986, it was successfully converted to WATFOR-PC using GKS (WATFOR) graphics available for the IBM-PC. This was accomplished in the University of Hong Kong Computer Centre and now the programme, in a slightly slimmed down form, runs successfully on any IBM-PC (standard machine) with monographics output. Essentially, it is graphically device-independent in the IBM-PC environment. It runs on an Amstrad 1512, on an OPUS II, and suchlike PC clones. The package has been usefully ported to the Institute of Technology MARA Transport Centre in Kuala Lumpur, where it is being developed for the Kelang Valley Region.49/ The model has been through many versions, but it is now entirely portable being first demonstrated at the Asian Productivity Council's Seminar on Strategic Planning for Urban Growth in Hong Kong in November 1986. In fact, this would not have been possible in 1982 when it was developed in Melbourne. Developments in microcomputing and in languages in the interim have solely enabled this.

The last project is a one-off piece of software developed also at the Institute of Technology MARA Transport Centre by cSpooner50/ in the summer of 1986 under British Council sponsorship. Essentially, this involves the construction of a bus information system for the Kuala Lumpur metropolitan area (Federal Territory) in which data is inputted and updated using dBASE III and analysed and presented using the spreadsheet LOTUS 1-2-3. Information on bus frequency and routes is ingeniously coded in dBASE III which is then accessed by LOTUS 1-2-3. The graphics capabilities of LOTUS 1-2-3 are used to display the route network, but the synthesis of dBASE and LOTUS is quite ingenious, yet problematic, thus demanding considerable analytical expertise, not simply acquirable through end-user or technical professional training. Spooner, the author, knew the software inside out and was able to make some rather innovative linkages not normally possible by nonanalytically-orientated users. Nevertheless, there are still considerable problems in its use and extension. The coupling of standard software in this way is cumbersome and there is no real substitute for a tailor-made package in this case. Rudimentary applications can be made using such general-purpose software, but there are severe limits in usage.

Finally, our students do not get much practice in large system task-specific programmes based on geographical information systems or suchlike. They experience SASPAC and some mapping, but very little programming. Twenty years ago, there was more on computer programming in British planning schools, and it is somewhat ironic that there has been a gradual deskilling as more and more standard software has come to fill the gap. This represents a mixed blessing, but it does reinforce the need for extreme care in the design of training programmes based on standard software. The field is diverse, local conditions are very different, and what is possible tends to determine what sights are set for such training. However, practice does vary in Western countries. In the United States, many universities are now insisting on basic computer skills in all courses, and this is bound to lead to different professional responses in time. But as yet there is no standard practice nor even a consensus about what the best training should be.

CONCLUSIONS: PROBLEMS AND PROSPECTS

Such a long paper as this one warrants a brief conclusion, as many of the themes have already been spelt out. The variety, diversity, and complexity of the environment in which information technology is now an integral part, dominates any proposals for education and training at present. It is an open question as to whether the ideological change combined with technological change, indicated earlier in this paper, will settle down, thus making the picture of impacts on society clearer, or whether as some commentators argue, such change is a natural feature of the society we are moving to. In any event, proposals for training must be separated into those designed to provide more robust and long-lasting skills in information technology, and those related to specific software-hardware which will inevitably become obsolete. In some senses, these issues are independent of who is being trained and at what stage, for in this period of transition, many groups involved in planning practice and education will need to be trained in the same tasks and skills. Although we have mainly concentrated on academic training in this paper, many of the proposals and issues broached are applicable to practice-based situations.

What is certain is that there is much training to be done for the technical professional role. Raising awareness in end-users and inculcating deeper skills in analysts are easier tasks to define. But in the middle ground where professional planners are involved in day-to-day and strategic problem-solving and design, there are many training issues to be dealt with pertaining to how planners interact with the whole continuum of software types and creatively synthesize these various types with respect to their technical expertise. This is an area where urgent research is required, but it exists within the wider organizational context in planning which also has to be explored with respect to information technology. The design of appropriate "orgware" implicit, for example, in figures 58 to 62, is a major task in all areas of application, not just planning, but planners need to be trained in the organizational skills required to use the technology in the best way. These challenges are widespread in society at present, and will remain in the forefront for a generation or more.

NOTES

1/ Daniel Bell, "The Information Society" in M. Dertouzas and J. Moses, eds., *The Computer Age: A Twenty Year View* (Cambridge, MA: MIT Press, 1979).

2/ Daniel Bell, *The Coming of Post-Industrial Society: A Venture in Social Forecasting* (New York: Basic Books, 1973).

3/ P. Nijkamp and W. de Jong, "Training Needs in Information Systems for Local and Regional Development and Planning in Developing Countries," *Regional Development Dialogue* 8 (Spring 1987): 72-119.

4/ S. Nora and A. Minc, *The Computerization of Society* (Cambridge, MA: MIT Press, 1980).

5/ S. Openshaw and J. Goddard, "Some Implications of the Commodification of Information and the Emerging Information Economy for Applied Geographical Analysis in the UK," *Environment and Planning A* (1987).

6/ Nijkamp and de Jong, "Training Needs in Information Systems."

7/ Bell, *The Coming of Post-Industrial Society*.

8/ A. Toffler, *The Third Wave* (New York: Bantam Books, 1980).

9/ M. L. Manheim and J. L. Schofer, "Urban Transportation Planning Information System for Use Developing Countries" in UNCRD, *Information Systems for Urban and Regional Planning: Asian and Pacific Perspectives* (Nagoya, 1986), pp. 249-302.

10/ N. Gringich, *Window of Opportunity: A Blueprint for the Future* (New York: Torch Books, 1984).

11/ UNCRD, *Information Systems for Urban and Regional Planning*.

12/ M. L. Manheim, "Editor's Preface," *Regional Development Dialogue* 8 (Spring 1987): iii-v.

13/ I. Masser and T. Wilson, "Information Management Training for Urban and Regional Planning," *Regional Development Dialogue* 8 (Spring 1987): 141-72.

14/ K. V. Sundaram, "An Integrated Approach to Training for the Establishment and Use of Information Systems for Subnational

Development Planning," *Regional Development Dialogue* 8 (Spring 1987): 54-70.

15/ J. Martin, *The Wired Society* (Englewood Cliffs, NJ: Prentice-Hall, 1978).

16/ M. L. Manheim, "The Third Computer Revolution: Implications for Training in Developing Countries," *Regional Development Dialogue* 8 (Spring 1987): 122-38.

17/ M. Batty et al., "Teaching Spatial Modelling Using Interacting Computers and Interactive Computer Graphics," *Journal of Geography in Higher Education* 9 (1985): 25-36.

18/ Masser and Wilson, "Information Management Training for Urban and Regional Planning."

19/ J. K. Friend and W. Jessop, *Local Government and Strategic Choice* (London: Tavistock, 1969).

20/ G. F. Chadwick, *A Systems View of Planning* (Oxford: Pergamon Press, 1971).

21/ M. Batty, "On Planning Processes" in B. Goodall and A. Kirby, eds., *Resources and Planning* (Oxford: Pergamon Press, 1979), pp. 17-45.

22/ S. M. Barrett and P. Leather, "Information Technology in Planning Practice." A Report to the Economic and Social Research Council, Environment and Planning Committee (London: ESRC, 1983).

23/ Lord Chorley, *Handling Geographic Information.* A Report to the Secretary of State for the Environment of the Committee of Enquiry into the Handling of Geographic Information, (London: HMSO, 1987).

24 M. Haslam, "The South Norfolk Experience: Developing a Word Processor Planning Application System," *Planner* 68 (1982): 106-7.

25/ K. S. Bardon, N. Stothers, and C. J. Elliott, "Directory of Computer Applications in Local Planning Departments 1984" (Birmingham: Computer Applications Research Group, Birmingham Polytechnic, 1984).

26/ P. A. Burrough, *Principles of Geographical Information Systems for Land Resources Assessment* (Oxford: Clarendon Press, 1986).

27/ Bardon, Stothers, and Elliott, "Directory of Computer Applications."

28/ I. Cullen, "Expert Systems in Planning Analysis," *Town Planning Review* 57 (1986): 239-51.

29/ M. Leary and A. Rodriguez-Bachiller, "Expertise, Domain Structure and Expert-System Design: A Case Study in Development Control" (Oxford: Department of Town Planning, Oxford Polytechnic, 1987).

30/ R. Sharpe, "Editorial," *Environment and Planning B* (1987) (Special Issue on Expert Systems in Planning and Design).

31/ Bardon, Stothers, and Elliott, "Directory of Computer Applications."

32/ Manheim, "The Third Computer Revolution."

33/ Barrett and Leather, "Information Technology in Planning Practice."

34/ H. Sazanami, "Assessing the Context for Information Systems for Urban and Regional Planning in Developing Countries" in UNCRD, *Information Systems for Urban and Regional Planning*, pp. 3-7.

35/ S. Papert, *Mindstorms: Children, Computers and Powerful Ideas* (New York: Basic Books, 1980).

36/ D. Michie, "Computer - Servant or Master?" in J. Reichardt, ed., *Cybernetics, Art and Ideas* (London: Studio Vista, 1971), pp. 191-5.

37/ Manheim, "The Third Computer Revolution."

38/ D. Moskovitz and D. Mammen, "Information Technologies in Government: Organisational and Management Issues" in UNCRD, *Information Systems for Urban and Regional Planning*, pp. 165-79.

39/ Manheim, "The Third Computer Revolution."

40/ United Nations Centre for Human Settlements (Habitat), *User's Manual: . Urban Data Management Software (UDMS)* 2nd ed. (Nairobi, 1983).

41 C. Webster, "ASUP - Applications Software for Urban Planning." Progress Report to the British Council on the UTM/UWIST Joint Research Project (Cardiff: Department of

Town Planning, University of Wales Institute of Science and Technology (UWIST), 1986).

42/ J. Ottensmann, "Analyzing Planning Alternatives Using Electronic Spreadsheets," *Journal of Planning Education and Research* 4 (1984): 33-42.

43/ M. Batty, "Information Technology in Planning Education" (Papers in planning research; no. 80) (Cardiff: Department of Town Planning, UWIST, 1984).

44/ Ibid.

45/ J. Ottensmann, *Basic Microcomputer Programs for Urban Analysis and Planning* (New York: Chapman and Hall, 1985).

46/ UNCHS (Habitat), *User's Manual*.

47/ Webster, "ASUP."

48/ Batty et al., "Teaching Spatial Modelling."

49/ P. Longley, "UWIST/ITM British Council Link Arrangement." Report of the Fourth Visit to Institut Teknologi MARA (Cardiff: Department of Town Planning, UWIST, 1987).

50/ R. S. Spooner, "UWIST/ITM British Council Link Arrangement." Report of the Third Visit to Institut Teknologi MARA (Cardiff: Department of Town Planning, UWIST, 1986).

14

THE DEVELOPMENT OF CURRICULA IN THE FIELD OF GEO-INFORMATION SYSTEMS: THE ITC EXPERIENCE

Gerard Linden

INTRODUCTION

A curriculum reflects the ideas and perspectives of an educational institute on a subject area in relation to the requirements of a target group and the institute's mission. Curriculum development is an iterative process in which objectives are defined, appropriate approaches to assessment and teaching planned, and adjustments made in the light of formative evaluation. Curriculum development even in an established subject area is a demanding and cumbersome task. The task becomes more complicated when developing curricula for an area such as geo-information systems (GIS) which is still in its infancy. This paper addresses the subject of curriculum development from the experience of the International Institute for Aerospace Survey and Earth Sciences (ITC) with curricula already produced.

The ITC was established in 1951 by the Government of the Netherlands as a contribution to international development cooperation. Its function is to disseminate and extend knowledge of aerospace surveys and their applications in the development of natural resources and improvement of the human environment. The ITC is expanding its activities in the development and use of geo-information systems because of the opportunities provided through this new technology, perceived need, and growing demand from developing countries.

For our purposes we define a GIS as a system for capturing, storing, checking, integrating, manipulating, analysing, and displaying data which are spatially referenced to the Earth. This is normally considered to involve a spatially referenced computer data base and appropriate applications software. A GIS contains the following major components: a data input subsystem, a data storage and retrieval subsystem, a data manipulation and analysis subsystem, and a data reporting subsystem. GIS is used here as a generic term for the whole field that encompasses land information systems (LIS). Many of the postgraduate and M.Sc. programmes at the ITC include components on the nature and potential of geo-information systems. Three twelve-month postgraduate diploma courses specifically devoted to cadastral, urban, and rural applications of GIS are also offered. The diploma courses are aimed at professionals in a senior technical position who will be involved in the selection and introduction of computer methods and GIS in their organizations. In addition to the present three postgraduate courses, M.Sc. programmes concerning the design and application of GIS are under development which will involve cooperation with a number of Netherlands universities.

The development of new curricula and the upgrading of existing ones are the subject of permanent discussion within ITC as it links with a (changing) perspective on technological possibilities and user requirements.1/ Part of this discussion is aimed at the identification of challenges and ways to respond.2/ A recent development has been the recognition of the need for management and planning in the field of GIS and related production facilities. This reflects a growing recognition of the importance of the user in an area previously largely concerned with the technology. Other issues are the concept of integrated systems and its impact on the organization and products offered and the recognition that geo-information is an economic resource. Although there is a fundamental difference between administrative-oriented information systems and geo-information systems as the former lacks the spatial dimension, the educational requirements for GIS mirror those for information technology (IT).3/

The paper addresses the problem of curriculum development in the field of GIS, with examples from ITC's experience. There are three main parts. Part one introduces the field of geo-information systems. The idea is to present a bird's-eye view of the area and adhering issues of relevance to curriculum development. The fundamental role of surveying and geo-information in development is discussed, as are the relevant changes in technology and the identification of the target groups according to function. Part two is on the ITC as an educational institute, its role in development, and the present regular GIS diploma courses. Part three discusses guiding principles for future curricula. Geomatics is introduced as a guiding principle, together with a number of derived challenges and an indication of their effects on the curricula. To substantiate this, an example of a recent developed course on integrated digital map and information production is given. The paper ends with a discussion on problems adhering to curriculum development for the field of GIS.

The conclusion is that, although technology is readily available on the market, the transfer of knowledge by teaching and training is in need of good curricula. Partly because of lack of established courses in GIS and hence curricula for reference, and partly because the demand for such courses is increasing, for practical reasons curriculum development sometimes has to fall back on less elegant methods than are theoretically available. The fast developments in the field of GIS add to the dominant presence of time constraints. To complement the mainly education-oriented content of the paper, some other important problems about teaching and training in GIS are mentioned.

THE FIELD

Before entering the process of curriculum development, it is important to delineate the field, describe its characteristics, and indicate its relevance and dynamics. At the same time, the target groups with their requirements have to be identified.

Geo-Information Systems, Geographic Data Processing, and Integrated Geo-Information Systems

A GIS attempts to model the distribution in time and space of natural resources and the social and economic indicators. It is in essence a toolbox providing the means to access, manipulate, and display data in order to arrive at meaningful information for users such as planners, researchers, and administrators. The data may come from many sources such as field surveys, air photography, remote sensing, existing maps, and records. A GIS is assessed primarily on its capabilities to analyse geo-referenced data.4/ Almost any discipline depending on or making use of information with a spatial component is a potential client for GIS applications.

Generally, a GIS is capable of performing the following functions: visually and numerically displaying a choice of the data in the data base; exploring relationships among spatial data sets; identifying locations which meet specified criteria; supporting decision processes on spatial trade-off problems; and estimating impacts through predictive modeling.

Geographic data processing can be depicted as a number of interconnected transactions from input via the data base and the adhering analysis facilities to output (see figure 64). This model illustrates the existence of a generally valid framework which, depending on the application area intended and/or the product(s) wanted, can be specified into different specific geo-information systems and/or production lines. Agreement on the content and level of detail of such a model enables a linkage with other important issues pertaining to the processing of geographic data, such as management, quality control, and user requirements (compared with figure 65). It also provides a vehicle for discussion in an interdisciplinary way, of common fields of interests and possibilities for data integration.

The model depicted in figure 64 shows remote sensing to be part of the input to a GIS. Remotely sensed data encompass in this model digital data from satellites (A), data from aerial photographs and photographs from space (B), frames from airborne video reconnaissance (C), and data from sensors from other platforms (D). Image processing is understood to be a technique within the field of remote sensing.

The emerging concept of an integrated system is based on the possibility to receive, store, and process data from different sources, for example, remote sensing within the same GIS.5/ The importance of using this concept for the development of the field of geographic data handling can be deduced from a number of recent publications.6/

The Fundamental Role of Surveying and Geo-Information in Development

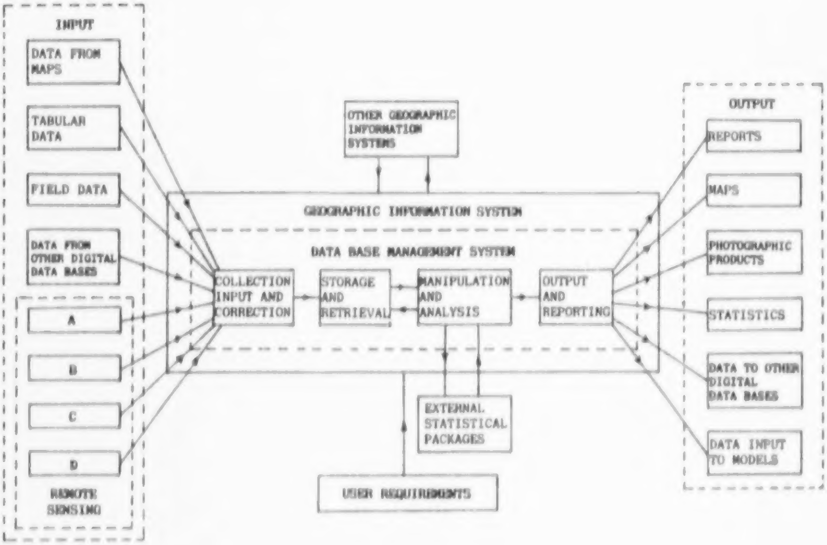
Surveying encompasses the inventory of natural and human resources, the assessment of their development potential, and the monitoring of change in human activities and environmental processes.7/ It is a prerequisite for purposeful action and contributes to decision processes in resource management for conservation and development. The solving of a problem or a complex of problems initiates a surveying process to procure relevant geo-information. Depending on the problem(s) to be solved and the prevailing constraints, a knowledge of the application field dictates the necessary survey design. Surveying is thus not a purpose in itself.

Geo-information encompasses all information which is referenced to the earth and thus has a location. Information can be simply defined in this regard as "anything that matters," which indicates again the importance of the user who is the one to decide if "it matters." Geo-information is not the sole property of one discipline or a couple of disciplines, but by character and use, is fundamental and instrumental to all disciplines with a spatial dimension.

Traditionally, geo-information is displayed in maps, but in the digital era (computer) maps are also the most important conveyors of geo-information. The main reason is their unrivalled effectiveness in conveying information to users.

Maps come in a wide variety. They range from topographical maps drawn to different scales for general reference to special maps for urban or rural planning, land suitability analysis, or engineering geology. To make these maps geographic data processing is necessary. This encompasses acquiring, identifying, and processing spatially referenced data and then defining, setting up, storing, and disseminating the relevant products (see figure 64).

Figure 64. Geographical Data Processing Model


INPUT
DATA FROM MAPS
TABULAR DATA
FIELD DATA
DATA FROM OTHER DIGITAL DATA BASES
A
B
C
D
REMOTE SENSING
OTHER GEOGRAPHIC INFORMATION SYSTEMS
GEOGRAPHIC INFORMATION SYSTEM
DATA BASE MANAGEMENT SYSTEM
COLLECTION INPUT AND CORRECTION
STORAGE AND RETRIEVAL
MANIPULATION AND ANALYSIS
OUTPUT AND REPORTING
EXTERNAL STATISTICAL PACKAGES
USER REQUIREMENTS
OUTPUT
REPORTS
MAPS
PHOTOGRAPHIC PRODUCTS
STATISTICS
DATA TO OTHER DIGITAL DATA BASES
DATA INPUT TO MODELS

Agarwal, Director General of the Survey of India underlines the importance of maps as follows:8/

> The planners, security forces, and law and order enforcement agencies as well as the administrators, economists, agriculturists, geologists , and all others

working in creative sciences such as engineering, etc., find maps to be indispensable aids for any development planning activity, since an overall view of the correct situation existing in respect of resources, the needs of the people, the feasible development alternatives, etc., can be provided by a map. Furthermore, the impact of any development on the human environment, etc., can again be monitored and assessed to provide feedback for corrective measures, only if maps of the areas covered are prepared after implementation of the plan/ development schemes. All development activity, whether it be building of a township, road, railway, flood control system, or an irrigation system requires *a priori* detailed information of the topography (physical and cultural) of the area. The ecological complexities of the environment can be assessed only with periodic systematic preparation of maps of the area concerned.

The impacts of the informatics revolution both on developed and developing countries are recognized widely.9/ Attention is often focused on the transfer of technology and its ramifications.10/ Still the importance of geo-information for the management and development of human and natural resources tends to be overlooked and underestimated by its obviousness. This results in a widespread low awareness of the potential contribution of GIS to the management of human and natural resources.11/ A large part of a country's development and administrative decisions has a spatial context. Geo-information is the common denominator of many different activities and thus contributes to the general economy and management of a country. Most of the data processed by, for instance, local and regional authorities have a spatial dimension. Important application areas of geo-information are, among others, (urban and rural) land-use planning, environmental analysis, agriculture and forestry, energy resource development, fisheries and ocean research, market research, real estate cadastres, engineering surveying and design, and utility line documentation.12/

Simple statistics on the availability of up-to-date maps of different scales in developing countries as compared to the developed world show clearly the enormous backlog in geo-information essential for development.13/ This observation highlights the need for increased surveying activities on a scale which is only possible with modern technology. At the same time, it is important to strengthen the national mapping agencies by tailor-made staff upgrading programmes and additional funds for the acquisition of adequate equipment.

The fundamental role of surveying and geo-information for development is so important that extra emphasis is placed on education and training.

> The full exploitation of geographic information requires users at all levels to be aware of the relevance and benefits of developments both in general information technology and in geographic information technology.... Education is essential to achieving this. Equally important is the existence of trained personnel at all levels, ranging from highly skilled developers of geographic information technology and systems to 'on the ground' operators of systems who need opportunities for training, both 'on the job' and formalized courses.14/

Relevant Changes in Technology and Needs

Surveying, geo-information, and geographic data handling are undergoing major changes due to developments in precise instrument, computer, and space technology. They concern terrestrial, marine, aerial, and space techniques connected with geodesy, topography, photogrammetry, hydrography, photo-interpretation, remote sensing and image processing, and all kinds of cartography. These developments make it possible to automate many of the tasks normally connected with geographic data handling.

The digitizing of geographic data transforms the traditional analogue map as a static carrier of information into a dynamic digital data base. This enables the user to manipulate and process data according to his needs and to display the results in map form. A GIS as a toolbox thus offers the user flexibility, analysis capabilities by modeling and applying statistics, and data integration and presentation options which are far superior to the possibilities of the analogue era.

Information about the land, its characteristics, and its relation with the inhabitants -- the manner in which they hold land, the settlements in which they reside, and their social and economic characteristics -- has become of increasing significance in modern society. The need for better management of (scarce) natural resources, be it for development or conservation, is especially felt in the rural areas. But change is also obvious in the continued but accelerating pace of urbanization, which is expected to show an exponential growth in the remaining years of this century. These observations and the growing acceptance of information as a production factor just like capital, machinery, and manpower, justify the expectation that the demand for spatially referenced information as provided by a GIS will increase.15/

DEVELOPMENT OF CURRICULA

Identification of Target Groups and Their Requirements

One of the problems of international education is its inability to identify clearly its target groups and their requirements.16/ Participants can come from any country and from various institutes and authorities. It is, however, possible to stratify the target group in analogy with the general automation practice into different categories according to level and function.17/

Table 14.1 indicates three levels of staff with a short description of their functions. The regular GIS courses at the ITC are predominantly directed at the management level. The accent of ITC courses is on the management of change, which explains that parts of the curricula are devoted to acquainting the participants with the work of the other two levels.

The ITC offers, like other Netherlands international educational institutes, courses at a high level. Participants in the GIS courses should have a B.Sc. or M.Sc. in a discipline appropriate to their function and adequate on-the-job experience. The course should provide them with a thorough understanding of the concepts and techniques of GIS in relation to their respective disciplinary backgrounds.

THE ITC AS AN EDUCATIONAL INSTITUTE

Within the field as described above, different approaches to curriculum development are still open. A number of factors as, for instance, ITC's mission play a role in deciding which approach to take. Other factors of indirect but noticeable influence are its tradition and accumulated experience and the feedback from a worldwide network of more than 8,000 alumni. Other important influential factors are the possibilities and constraints of the present situation.

ITC's Rōle in Development

To explain the approach the ITC takes when developing curricula, it is important to elaborate on ITC's role in development.

ITC's contribution to development is predominantly in the field of education and applied research in surveying, mapping, and geographical data handling fundamental to most development activities. The ITC traditionally specialized in the development and utilization of techniques for surveying natural resources by means of aerospace imagery. The accent was mainly on map making.

TABLE 14.1. THREE LEVELS OF STAFF AND THEIR FUNCTIONS

Category	Functions
1. Management	
System Manager	To assemble and analyse user needs, develop design concepts, oversee procurement and installation, manage the system, maintain contact with users, and define necessary changes in the system.
Data Base Manager	To design data structures and formats, and to manage the creation, utilization, maintenance, and expansion of the data base(s).
2. Technical Support	
System Analyst/Designer	To transform concepts into detailed system design, evaluate proposals, undertake benchmark tests, supervise installation, conduct problem analysis, and design changes in the system.
Programmer	To programme utilities, algorithms, and interfaces.
System Engineer	To ensure smooth running and maintenance of the components of the system.
3. Operation	
System Operator	To operate the individual components of the system for data collection, processing, and presentation.
Terminal Operator	To input high volume text data (where appropriate).

With the advent of the computer attention shifted towards computer-assisted cartography and image processing. The rapid increase in technological possibilities for surveying and infor-

382

mation management introduced an imbalance in information utilization procedures. The results of applied research should maintain a balance between the development of data collection, processing, and interpretation technologies and the utilization of the resulting information for the management of resource development. This also underlines the firm belief that an interdisciplinary approach to human and natural resources management is called for. The research activities are embedded in a consulting and educational environment, while the educational activities rely substantially on the experience gained in applied research.

The educational system is international in nature, mainly at the postgraduate level and intended primarily for participants from developing countries. The emphasis is on mid-career training and the average age of the participants is 32. The courses are very intensive, taking a full twelve months. In general, the time is divided into lectures and practicals (see table 14.2).

English is used as the teaching language, while other major languages are used upon request. In addition to the regular course programme, the ITC provides special courses and advisory training services as well as technical expertise on a consulting basis.

Present Regular GIS Diploma Courses at the ITC

As previously mentioned, almost all educational activities at the ITC have a more or less strong connection with the subject of geographic information handling. There are, however, three (one-year) postgraduate courses especially dedicated to training in the field of geo-information systems with accent respectively on cadastral, urban, and rural applications.

The GIS-cadastral course is realized in cooperation with, and with substantial input from the Technical University of Delft. For some parts of the curriculum, guest lecturers from other institutes or universities in the Netherlands or abroad are invited. The teaching staff is a cross section of all departments with outside experts if adequate.

In compliance with ITC regulations, the three GIS courses are supervised by a course board in which all participating departments and the outside cooperating institutes are represented. For the day-to-day management of each separate course a Director of Studies is appointed.

The topics of the first GIS cadastral course in October 1985 are depicted in table 14.2. The addition of the GIS urban and rural courses in 1986 resulted in the adaptation of the programme

TABLE 14.2. THE SUBJECTS OF THE FIRST GIS CADASTRAL COURSE IN OCTOBER 1985

	Subject Group	Subjects	Hours of Lectures/ Practicals
0	Preparatory subjects	Maths, Statistics, Programming, Surveying, Photogrammetry, Cartography	133/74
1	Introduction to GIS	Definitions, theory, applications, models	32/-
2	Defining the problem area	Land, the economy, transfer, security, planning	36/-
3	Environmental characteristics	Political, cultural, legal, socioeconomic, technological, institutional	50/38
4	Information required by problem area	Cadastres, parcels, identifiers, linkages, confidentiality	20/-
5	Data required to derive information	Data types and quality, technical and legal	26/-
6	Technology		
	6.1 Geo referencing	Systems and conversions	8/-
	6.2 Data gathering	Land Survey, Valuation, Photogrammetry, Photo-interpretation, Remote Sensing, Socioeconomic, administrative, and environmental data, digitizing existing graphics	157/98
	6.3 Mapping technique	Metric and semantic data, standards, methods of presentation	64/70
	6.4 Data base technique	Requirements, data systems, models, DBMS	50/50

TABLE 14.2. (continued)

Subject Group	Subjects	Hours of Lectures/ Practicals
6.5 Data -- to information processing	Data types and sets, editing, manipulation, analysis, modeling	28/34
6.6 Functional design	Administration and graphic parts of cadastral data base	10/30
7 Resources required	System specification, selection, personnel needs, education, retraining	26/-
8 Existing systems	Overview of selected systems	10/8
9 Systems engineering	Applied to design/implementation of GIS	15/-
10 Case studies	Case study and computer simulation	25/20
11 Final project	Project to integrate all subject matter	-/240
		690/662
	Subtotal	1352
	Directed studies	302
	Technical visits	80
	Assessment	40
	Statutory and other holidays	120

Source: G. McGrath, "The Challenge to Educational Establishments: Preparing Students for a Future in GIS/LIS" in M. Blakemore, *Proceedings* (London: Auto Carto London, 1986).

as reflected in the overall structure of the courses. Taking into account the common elements of the three courses (GIS is in essence a toolbox!), common building blocks for the curricula were designed. The structure of the present courses is similar, starting with the first block of three months' duration, in which general principles of GIS and a number of basic skills as regards equipment and computers are treated. The second block of six months' duration, is mainly intended for specialization, while the last block of three months' duration, is devoted to a final project. The participants have been requested before entering the course to prepare material for the final project relevant to their own country situations.

When applicable, parts of the curriculum such as theory of GIS and data bases are common to all three courses. Guest lectures, excursions, or training in some GIS software are also common to the three courses. The idea is to emphasize GIS as a toolbox deriving meaning from the specific application area. To broaden the scope of the participants, from time to time attention is given to applications in areas outside their specific course.

The following is a short description of the individual courses. More details on the characteristics of the curricula can be found in the course brochure.18/

The GIS cadastral course aims to prepare participants to manage the design, implementation, and maintenance of a GIS for cadastral applications. Its specific objectives are to enable participants to: Establish a cadastral system, national or municipal, for legal, fiscal, and other purposes; Upgrade or improve cadastral systems; Create and develop a municipal management information system; Expand an existing cadastral system into a multipurpose cadastre or large-scale GIS for use in title registration, valuation and assessment, administration and social services, census services, and the development of utilities, services, and transportation.

A GIS for cadastral applications is a tool for legal, administrative, and economic decision making. It consists, on one hand, of a data base containing spatially referenced land-related data for a defined area and, on the other hand, of procedures and techniques for the systematic collection, updating, processing, and distribution of the data. A primary component of a GIS for cadastral applications is the uniform spatial referencing system for the data in the system, which also facilitates linking data within the system with other land-related data.

The GIS urban course aims at the planning application of urban information systems. Many cities in the developing world are currently contemplating to have a computerized GIS as a vital element in their strategy to improve the quality of urban planning and management.

DEVELOPMENT OF CURRICULA

The course offers a broad panoramic view to introduce the urban technical staff to a variety of possible systems and their potential in relation to eventual applications. Emphasis is on urban physical planning (land-use planning, infrastructure planning, and housing), but links with other fields of planning (traffic planning and educational planning) and land management (cadastre and utility network maintenance) also get ample place in the course. The course is aimed at active planners in senior technical positions who will be involved in the selection and introduction of computer methods and urban information systems in the planning office and in urban administration. Upon returning from the course, a successful participant can participate in the selection of suitable software and hardware systems and in the definition of data base criteria. He (or she) will be able to manage and develop planning and mapping applications of the system(s) that may be eventually installed, in close cooperation with other municipal agencies. He (or she) will also be able to understand the potential of data maintained by other agencies and participate effectively in discussions on organizational and technical aspects of data linkages.

The objective of the GIS rural course is to train (senior) people in the available hardware and software for spatial analysis and in surveying the possibilities of the use of these techniques for resource management (development and conservation). Therefore, the course will include elements of computer technical/operational aspects, elements of resource surveys, and elements of management and planning. At the end of the course, participants should be able to evaluate which techniques of data collection, processing, presentation, etc. are feasible in their own environment. Besides the lectures common to all streams, the following specific rural development aspects will be taught in the common block: economics, agricultural economics, planning theory, land ecology, land evaluation, and other subjects, depending on the background of the participants.

The curricula are under constant scrutiny, as obviously a mature and balanced curriculum cannot emerge within a short time. This will result in the adaptation of parts of the course elements, with a heavier emphasis on data base techniques, both theoretical and practical. The installation of an Arc/Info system will cater for the need to train participants in the use of dedicated GIS packages on the market. For the ITC, the beneficial side effect of these discussions is that GIS as an area provides a platform for stimulating intellectual debate between a variety of disciplines.

GUIDING PRINCIPLES FOR FUTURE CURRICULUM DEVELOPMENT

The above description illustrates the present approach of the ITC to the regular GIS curricula. The courses have been designed on the basis of a careful and cautious preparation of existing modules which are modified and adjusted as necessary. The process consisted of rounds of discussion on and subsequent revision of the concept curricula with the active involvement of a great number of staff with different disciplinary backgrounds. This incremental, and hence, often conservative approach can lead to discussion when confronted with idealistic and futuristic concepts such as geomatics.

Major Orientations: Geomatics and Derived Challenges

Geomatics,19/ a term introduced by the Surveyor General for Québec, pertains to the application of computer and communication technology to the capture, organization, management, and application of spatial information. It deals with all aspects of purposeful spatial data base creation, organization, maintenance, access, and linkages, including the standards and protocols associated with such aspects. The need for this concept derives from a number of significant characteristics of the information involved, which sets it apart from all other computerized information such as that covered by informatics. The data is location-specific; it is very costly to collect and maintain; the amount of data to be stored, transformed, and presented is very large; and the applications are often unpredictable and extremely varied. The concept of geomatics provides the framework and the means to meet the needs for spatial information in development decision making. Geomatics is of importance due to its intellectual appeal and the possibility of identifying actions in line with this perspective. It provides an orientation to the almost unnoticed discussions and subsequently influences the decisions on actions to be taken. It is also of importance to GIS which is considered to be a subset of geomatics, as the latter explicitly deals with the creation of a nationwide spatial information environment comparable to other infrastructures such as electricity, transportation, and water supply. The concept is a tribute to the value of spatial referenced data for "a nation." Although admittedly the realization of the geomatics concept is beyond ITC's present capabilities, it serves effectively as a guideline for the identification of and response to challenges for the immediate future.

These derived challenges are instrumental to effectuate ITC's perspective on the field, and hence, are of influence to the policymaking process. They also have direct influence on the curriculum design. Without being exhaustive, the following challenges can be identified.20/

The first challenge for the coming years is to master the concept of integrated systems in all its facets. The introduction of the associated hardware and software must serve the need to integrate data inputs from all available sources into digital data bases for use in a growing variety of application areas. The second challenge is to include pragmatically in the curricula those elements that bear on the socioeconomic and sociocultural aspects of introducing this new technology in different production environments. The third challenge is to respond to the recognition that geo-information is an economic resource and that its optimal exploitation will depend on the effectiveness of the geomatics infrastructure to access, share, and use the resources in the development of a country. The development of a geomatics information infrastructure fits in with the idea of "institutions" as the nodal points in the information network.

This touches upon the Netherlands Development Aid's (ITC's major funding agency) important policy concept of "institution building." Following this concept, the Netherlands Institute for International Education served as a counterpart for a number of years to a similar institute in the developing world. The idea is that after a specified period the receiving institute should be at the same level as the Dutch counterpart. It is obvious that for the next decade, institutions would need personnel to manage the transition from existing to new technology to meet the escalating demand for maps and geo-information for development decisions and administration. Awareness of the need for a geomatics infrastructure and sensitivity to and realism about user needs, coupled with the ability to determine for local circumstances the applicability of certain technologies and data sources and their incorporation into practical production lines would be required of the personnel who would lead this transition.

The fourth challenge is to contribute to the education of the staff with the aim of strengthening the innovative, productive, and management capabilities of those institutions. This necessitates research on the geo-information production requirements of developing countries, as well as providing assistance to those countries in implementing responsive geo-information programmes and advising them on the appropriate, practical means for the day-to-day production of information.

The goal is to increase ITC's contribution to development by cincorporating explicitly in the curricula the research issues related to management, quality control, standards, and identification of user requirements, as well as the technological subjects *per se*.

Some Effects on Curriculum Development

The ITC has responded in a timely manner to the emerging interest of the professional world in GIS. This has resulted in the present regular diploma courses. In comparison with the courses of other institutes of higher learning, these courses as represented by the volume of students, the subjects covered, and the accent on the managerial aspects of introducing GIS technology, are a unicum in the world. A further strengthening of this platform by improving the present courses and introducing new courses also on the M.Sc. and Ph.D. levels is foreseen. The challenges identified above will guide curriculum development.

The present courses contain several elements which are indications of developments to come. Although the subjects of the courses are different and fall within the scientific responsibility of separate departments, the curricula are organized in such a way that 30 per cent of the modules are commonly used in all the courses. It is expected that this picture will not change when other GIS courses are added. This indicates a development towards integration and cooperation between the disciplines involved in the different fields of application. In order to facilitate this development, a conscious effort towards a clear and modular curriculum design for the contributing courses is necessary.

The content of the courses also indicates a shift in the orientation of the ITC from surveying to application, with an open eye to management issues pertaining to the introduction of GIS technology. This process brings a hitherto unknown but diverse user-population into the ITC area of interest.

The number of regular GIS courses will increase the number of different departments involved. Considering the common interest in the data management and analysis part of GIS, a regular course dealing with the technical aspects of GIS should complement the range of courses. Together, the courses form a platform which provides cross-fertilization between the departments and their fields of scientific interest.

Practicals and training on specialized hard- and software are essential to the curricula. It is almost impossible to teach GIS without hands-on experience with relevant exercises on a dedicated GIS package. Present practice shows the successful use of simple microcomputers to introduce the students to computing and to train them in statistics and text-oriented computer applications. The developments in chip technology indicate that in the near future a large part of the training requirements could be met by the use of microcomputers and low-cost peripherals. For educational, research, and consultancy reasons the high end of the GIS hard- and software market should not be neglected. Experience indicates that students in a GIS course should have access to a dedicated GIS for hands-on training and general reference during the course.

The design and realization of a range of short courses for different purposes should complement the existing supply of twelve-month courses. There is a growing demand especially from persons higher in the hierarchy of, for instance, Survey Departments for short courses to refresh and update their knowledge. It is in this area that cooperation with other universities could provide the necessary flexibility in the planning and organization of courses.

Example of a Recently Developed Course on Integrated Digital Map and Information Production

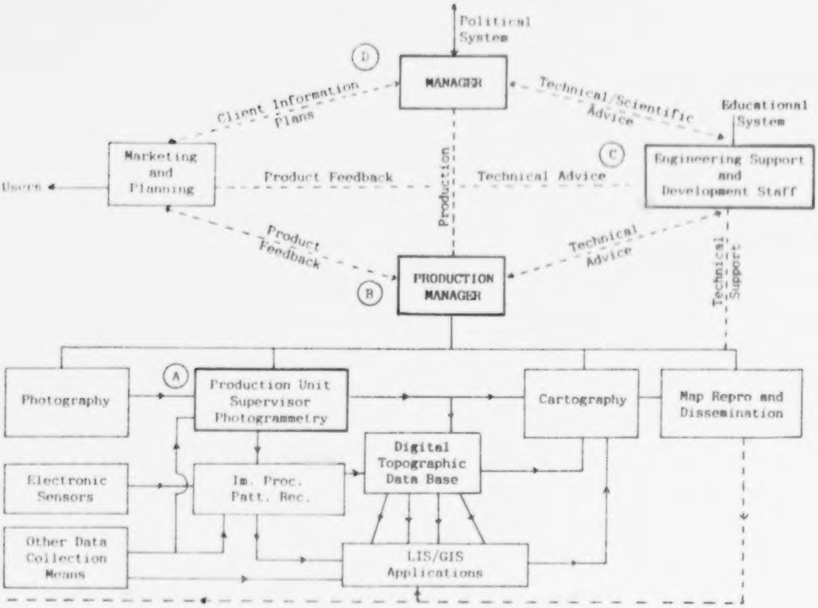
The ITC approach to curriculum development is described below.

At the request of the Survey of India (SOI), the ITC designed and conducted a three-month special course for those officers of the SOI who would be responsible for the implementation of the Modern Cartographic Centre (MCC). This centre is part of the realization of a more ambitious plan to modernize the SOI. Considering the size of the SOI and the aims of the plan, this undertaking is unprecedented in the world. In line with emerging ITC philosophy, the special course for the MCC of the Survey of India is seen as an extension of the regular courses in GIS.

Figure 65 shows the overall framework of the course and its linkages with courses on other topics, including GIS. It shows a client-oriented management structure on top of a conglomerate of technology linking diverse disciplines such as photogrammetry and cartography with remote sensing and GIS applications. Within this model, A, B, C, and D are considered to be the principal educational targets.21/

Models of this kind are very helpful when developing curricula in a multidisciplinary environment by providing a framework for discussion and subsequent decision making. Their translation into concrete building blocks for a course is, however, difficult due to a number of factors. The (concept) curriculum22/ describes the situation facing the designers of the curriculum as follows:

Figure 65. Framework of the ITC course and Its Linkage with Other Courses


Political System
D
MANAGER
Client Information
Plans
Technical/Scientific Advice
Educational System
Marketing and Planning
Users
Product Feedback
Production
Technical Advice
C
Engineering Support and Development Staff
Product Feedback
Technical Advice
PRODUCTION MANAGER
B
Technical Support
A
Photography
Production Unit Supervisor Photogrammetry
Cartography
Map Repro and Dissemination
Digital Topographic Data Base
Electronic Sensors
Im. Proc. Patt. Rec.
Other Data Collection Means
LIS/GIS Applications

A. Links between unit supervisors in day-to-day production.

B. Responsible for all aspects of day-to-day production technology adaptation.

C. Responsible for development of new production capabilities and technical support.

D. Responsible for inception, justification, and execution of programme.

DEVELOPMENT OF CURRICULA

> Integrated digital map and information production is in its infancy and not very many facilities exist where these are used in a routine production environment. Courses in automated or computer-assisted cartography focus on certain elements but in most cases fail to pull the material together to reflect the words 'integrated' and 'production'.

In the case of this special course the guiding principle was that the participants should be responsible for the installation and bringing into production of an integrated map production facility some months after completion of the course. Thus, before returning to India, the participants underwent training provided by the vendors on the equipment.

The curriculum design had to take the above into account by giving the participants an insight into three major aspects of the management, use, and operation of an integrated map and information production facility. The first aspect concerns the linking of data sources to user-defined products through the use of integrated digital techniques. The accent is on decision situations facing the person(s) responsible for a specific production line such as map revision and Digital Elevation Models (DEM). The second aspect pertains to assessing the definition of a digital topographical data base. The accent is on exposing the participants to the complexity of information classification, data structure, qualification of data, etc. The third aspect is facility management, comprising hard- and software maintenance, documentation and administration, system security, tape management, etc. Insight into these three aspects should enable the participants to assess the strengths and weaknesses of the system.

The next step was to divide the available twelve weeks into different subject areas in a logical, effective, and practical way. The resulting five blocks of different durations cover the following topics: one week: Management issues on Integrated Digital Map Production; four weeks: Photogrammetry, Cartography and Remote Sensing, Technology Update; four weeks: Case studies of Integrated Production lines; two weeks: Data Base Design and Management Issues pertaining to Facility Management; and one week: Testing of Integrated Digital Map Production System.

For each block a detailed programme of lectures and practicals has been worked out on a day-to-day basis. The emphasis on documentation is primarily necessitated by the demands of evaluation. The top-down approach to curriculum development is evaluated from the bottom up by weekly feedback sessions with the participants, followed by intensive discussions between the staff involved. The feedback will be used to improve the curriculum and to design a twelve-month M.Sc. level course on the same topic.

Discussion: Theory and Practice of Curriculum Development

Theoretically, there are many means of assisting the curriculum development process. To ensure a comprehensive view of the whole process, theoretical models such as that proposed by Taba can help to structure the design and eventually the evaluation activities.23/ This approach can counter the inclination when evaluating a curriculum to consider and assess the programme as a set of separate educational activities. Additional support can be found by using a checklist of curriculum characteristics relating to issues such as the educational, professional concept, the "final requirements" of the course, the target group, the structure of the programme, and the educational strategy.24/

ITC's curriculum development follows these theoretical models. In practice, however, the resulting curricula undergo considerable changes before the course content can actually reflect the requirements and perspectives. The lack of course reference material, the fast developments in the field itself, and the increasing demand for courses sometimes enforce the use of less elegant methods than are theoretically available.

The process of monitoring and evaluating the curricula is rather cumbersome and time consuming. Improving a curriculum depends largely on a careful design of the evaluation process. As evaluation depends partly on the theoretical basis for curriculum development, an iterative but time consuming approach is necessary. In analogy with the field of information system development, a cosmetic upgrading of the situation by calling it curriculum prototyping could cover up some of the obvious frustrations.

A number of other important problems were not discussed in this paper. Educating GIS course participants on the agents of change has to encompass raising awareness for nontechnical factors pertaining to information systems such as sociopsychological and organizational issues. In practice, the introduction of information systems often fails because these factors are ignored. A recent article in a Dutch professional journal *Informatie* revealed that this is the real problem in teaching how to design information systems. The authors, Creusen and Mantelaers25/ stress the importance of a knowledge of the organizational, sociological, and psychological issues in designing an information system. For example: How do organizations function? What role does information play? How do individuals within organizations process information? What are the alternative possibilities for information provision? Is there interaction between organization and information?

In the field of geographic information handling an added complication is that the context varies with the application, although for some applications production lines can be detected. The characteristics of GIS and the accent on data manipulation and analysis are fundamentally different from the usual business type of information systems. In view of its flexibility, GIS is less oriented towards production and more akin to decision support systems. This demands a type of professional with an equally flexible attitude as opposed to the traditional, mechanistic view of information provision within organizations.

The paper has concentrated on the educational, theoretical, and practical implications of curriculum design. There are, however, logistic problems which sometimes negatively influence options. These problems relate to the scarcity of staff with relevant experience, the financial burden of keeping up-to-date with technological developments, and the availability of relevant course material. Similarly, the theoretical basis of GIS applications is not without problems. As mentioned earlier, GIS gets its "face" from the area of application. As a toolbox, GIS is readily available on the market in the form of software packages. Likewise, the hardware is improving in terms of performance/cost ratio year after year. The knowledge of and experience with different applications, however, are lagging behind. The main problem is that, by its nature, automation needs formalization. Many of the application fields only have partial access to computer methods. This implies a mixed strategy in which, depending on the degree of formalization possible, GIS is considered together with other methods of information provision. This again necessitates a flexible and imaginative use of available quantitative and qualitative analytical methods.

In this regard it is important to invest in educating persons with different disciplinary backgrounds on the possibilities and constraints of GIS in the various application areas. From the above it is also clear that it will take some time before the full impact of GIS on day-to-day activities in government and business will be felt.

NOTES

* As part of the views expressed are based on internal ITC communication still under discussion, the paper is the sole responsibility of the author and does not necessarily represent official ITC policy or what the ITC views as

desirable processes of curriculum development.

The critical contribution to an earlier version of the paper by Richard Groot and Alan Harding is gratefully acknowledged. The content, however, is the responsibility of the author.

1/ G. McGrath, "The Challenge to Educational Establishments: Preparing Students for a Future in GIS/LIS"; and J. Drummond and P. Stefanovic, "Transfer of High Technology to Developing Countries" both in M. Blakemore, ed., *Proceedings Auto Carlo London* (London, 1986).

2/ International Institute for Aerospace Survey and Earth Sciences (ITC), "Strategic Plan 1987-1992, Photogrammetry Department" (Enschede, 1986); and its "Draft Strategic Plan" (Enschede, 1987). See also R. Groot, "Geomatics: A Key to Country Development?" (Paper for the Eleventh United Nations Regional Cartography Conference for Asia and the Pacific, Bangkok, 5-16 January 1987), p. 12.

3/ Chorley Committee, "Handling Geographic Information." Report to the Secretary of State for the Environment of the Committee of Enquiry into the Handling of Geographic Information, chaired by Lord Chorley (London: Department of the Environment, 1987).

4/ P. A. Burrough, *Principles of Geographical Information Systems for Land Resources Assessment* (Oxford: Clarendon Press, 1986).

5/ F. Arnold, M. J. Jackson, and M. Ranzinger, eds., "A Study on Integrated Geo-Information Systems." EARSEL report (1986); and J. A. T. Young, "A U.K. Geographic Information System for Environmental Monitoring, Resource Planning and Management Capable of Integrating and Using Satellite Remotely Sensed Data" (Nottingham: Remote Sensing Society, 1986).

6/ D. Rhind, "Remote Sensing, Digital Mapping and Geographical Information Systems: The Creation of National Policy in the United Kingdom," *Environment and Planning C: Government and Policy*, 4 (1986): 91-102; and Chorley Committee, "Handling Geographic Information." For a review of research and development in integrated GIS, see M. Jackson and D. Mason, "The Development of Integrated Geo-Information Systems," *International Journal of Remote Sensing*, 7 (1986): 723-40.

7/ ITC, "Draft Strategic Plan."

8/ C. W. Youngs, "Policies and Management of National Mapping and Charting Programmes" (Paper for the Eleventh United Nations Regional Cartographic Conference for Asia and the Pacific, Bangkok, 5-16 January 1987), p. 22.

9/ A. Cordell, "The Uneasy Eighties: The Transition to an Information Society" (Background study 53) (Hull: Science Council of Canada, 1985); and Khadija Haq, ed., "The Informatics Revolution and the Developing Countries" (Paper prepared for the North-South Roundtable Consultative Meeting, Scheveningen, The Netherlands, 13-15 September 1985).

10/ Drummond and Stefanovic, "Transfer of High Technology to Developing Countries."

11/ Chorley Committee, "Handling Geographic Information."

12/ See Burrough, *Principles of Geographical Information Systems*; Arnold, Jackson, and Ranzinger, " A Study on Integrated Geo-Information Systems"; and Chorley Committee, "Handling Geographic Information."

13/ See Groot, "Geomatics."

14/ Chorley Committee, "Handling Geographic Information."

15/ Ibid.

16/ H. Van der Horst, ed., "Needs, Relevance and Standards in International Education" (Proceedings of the FION/NUFFIC Conference, The Hague, 19-21 December 1984).

17/ McGrath, "The Challenge to Educational Establishments."

18/ ITC, Brochure of GIS Courses (1987).

19/ Groot, "Geomatics."

20/ ITC, Draft Strategic Plan."

21/ Ibid.

22/ ITC, "Provisional Syllabus, Special Course for the Modern Cartographic Center of India" (Enschede, 1987).

23/ Taba, (1962); and F. Knoers and J. Van der Hoogen, "How to Design a Curriculum" (Nijmegen: Univ. of Nijmegen, 1981) (original Dutch).

24/ A. W. Chickering and D. Halliburton, "Developing the College Curriculum" (Washington, 1977).

25/ M. Creusen and P. Mantelaers, "Teaching the Design of Information Systems: An Educational Problem," *Informatie* (5: 1987): 429-38 (original Dutch).

15

TRAINING FOR INFORMATION RESOURCES MANAGEMENT IN PUBLIC ADMINISTRATION: UN/DTCD'S CASE

J. H. Oyugi and Itoko Suzuki

INTRODUCTION

At present, the United Nations Department of Technical Cooperation for Development (UN/DTCD) is backstopping 358 technical cooperation projects1/ in developing countries, excluding cost-sharing for indicative planning figure (IPF), including 113 in Africa, ninety-four in Asia and the Pacific, fifty-three in Arab States, twelve in Europe, eighty-three in Latin America, and three interregional/global projects, which have an input component in management information systems, data processing, data banks, data collection, information retrieval, information services, word processing, computer programmes/sciences, data base management, data processing services, data transmission, and/or information science.

Experiences in developing countries in these projects have often recorded, among others, inconveniences resulting from abuse and misuse of information systems, overinformatization, lack of security safeguards, breakdown of computers, costly back-up systems, systems and hardware maintenance problems, absence of international regulatory mechanisms, proliferation of information systems without planning, and excessive centralization in administrative operations.

These experiences call for emphasis on management of information systems.2/ For the optimum use of information technologies, it is essential that public managers, including policymakers and line managers, manage the utilization of computerized information systems as scarce organization resources in public administration. Information resources management cannot be overemphasized in the light of the cost involved in information systems and the significant impact of their utilization on public administration and society as a whole.

TRAINING FOR INFORMATION RESOURCES MANAGEMENT

The management of government information systems has to consider establishing a long-term strategy and policy for information resources management, including a systematic methodology of computerization, information planning, priority setting, and creating appropriate lead organization and coordination mechanisms. Such a strategy should also take into consideration overall direction, the prevention of waste, the sharing of resources, procurement and standardization policies, and human resource development. Appropriate and adequate regulations and laws are necessary to govern the major issues of management of information systems.3/

In this paper, human resource development is singled out as a vital factor for information resources management. Appropriate staffing and training required for the development and use of information systems also enhance the coordination of information systems and sharing of resources, thus maximizing the efficient use of government information systems. How to organize, develop, and maintain the required information systems professionals and personnel is a fundamental management question. Essentially, it involves policy development on staffing and training of information personnel. This paper asserts that policy development for staffing and training should be part of the information systems development and that among other training, user-managers' training should be accentuated to secure effective management of information systems. It further highlights the approach of the UN/DTCD in senior managers' training to be given as an initial sensitization programme, which was intended to facilitate policy development for the promotional use of information technologies in public sector organizations.

STAFFING AND TRAINING

Information Systems Staffing Policy

Many governments have previously failed in devising policy and regulations regarding information systems personnel, while the public sector showed a dramatic increase in their needs. Lack of clear objectives in government information systems development often resulted in imbalance between systems personnel and other computer resources. In some cases, information systems professionals were borrowed from the private sector on contract, or were recruited under technical assistance. A remarkable shortage was observed in many governments for information systems professionals including systems analysts, programmers, maintenance personnel, network specialists, and data base administrators. Even if temporary staff are filled by government trained staff, once they are well-trained, their exodus to the private sector again brings shortage of staff in the public sector. Difference in wages between public and private sectors for competitive information systems professional jobs gives rise to the issue of career planning for the trained staff, adjustment between information systems life cycles and staff needs, wage/salary incentives for information systems professionals, and issues in job analysis and position classification in the civil service.

Staffing policy encompasses these and other issues, including assessment of needs of different types of professionals, know-how requirements for different professionals, and planning on the quantity and types of professionals for planned systems. It also provides an indication for training in systems development, operation, and maintenance.

In assessing the overall staff resources in government for information systems development and management, existing resources must be reviewed in the light of existing computer resources in the government, or in a particular organization. Evaluation of personnel and personal capacity of each individual staff (specialist) must be simultaneously undertaken during planning of human resource development. External resources outside the government, i.e., consulting firms, universities, and vendors, should also be evaluated. Staffing plans and policy should be in any case a part of the government information plan or policy. They should also be linked to training plan and policy. Long-term planning for staffing needs should be derived from the overall information systems strategy of the government or agency. For a short-term or medium-term plan, the life cycle of a planned information system can be a guide for the adjustment of a staffing and training plan.

Training Policy

To define and establish a training policy, policymakers in government must have a clear understanding of the skills required for information systems personnel. The information policy itself must answer the basic questions of who and how many should be trained, and the content and timing of training for defined objectives. Important in this policy definition is the need to make a clear distinction between those who require basic skills and practice, and other professionals who require substantial knowledge, experience, and leadership ability, such as the head and senior officials of the national computer centre.

As training is a function of human resources management, its policy should be formulated within the context, i.e., a continuous management process, in which career plan and staffing, as well as maintenance, support, and development of organizational skills and knowledge must be considered. For this reason, user-managers must be knowledgeable about the methodology of policy development, and they must have a clear perspective on systems to be developed, and skills needed for the informationsystems personnel. In many developed countries, it is now a common practice or a requirement to receive basic executive training in the use of information systems. An increasing number of developing countries now follow the practice. UN/DTCD's executive training programme was born out of this context.

Structure of Training

In the above-cited technical cooperation projects backstopped by the UN/DTCD, training is often included, but the ratio of equipment purchased and training is not adequate. For optimum use of the equipment purchased, training cost could be two to three times more. Usually it involves external experts/short-term consultants to organize in-house training or external training through grants of UN fellowships or study tours organized in schools or institutions in foreign countries.

The following categorization may be made for training:

A. Information systems specialists training (systems analysts, programmers, data base specialists, etc.)

B. Systems support training (operators, data entry personnel)

C. User training (general administrators as end-users, senior and middle managers/policymakers)

D. Trainers

As to A and B categories, the emphasis should be on a core group of systems analysts, programmers, operators/data entry personnel, and technical specialists. The training of senior information specialists, e.g., software professionals should also include sessions on organizational management and communications skills to improve interaction and dialogue between users and technical personnel.

User training (category C), and training of trainees (category D) are still new in many developing countries. Initial training for category C should facilitate dialogue between systems personnel and users, which would, in turn, facilitate systems development and effective utilization of computer resources. Category D training, is rather scarce. Trainers are, in the beginning, scarce in computer training. Their development will no doubt foster the expansion and improvement of in-service training through the training of trainers.

Continuous Process for Training

Initial training for these professionals is usually undertaken in universities, computer centres or training institutions, or specially organized personnel by the interested government organization. There should be organizational support to enable them to continue by (a) daily practice and (b) mid-career development/advanced training to upgrade their knowledge and skills.

As training is part of a continuous process of information resources management, managers have to make a decision on priority areas in information systems planning and related training, i.e., when to procure equipment/software, and staffing to develop, maintain, and support the systems. Since these managers are also the recipients of the benefits of the information systems to be developed, they have to be aware of the actual increase in productivity to be gained by the developed systems. For this reason, user-managers must know the profitable areas of the functions to be computerized. They are, therefore, the first group of human resources to be trained.

USER TRAINING

End-Users

Many governments now recognize that all their employees are potential end-users of information systems and make efforts to provide introductory training programmes. These programmes include word processing for secretaries, and spreadsheet/project analysis techniques for operational staff. These programmes are practical and therefore bound to be feasible when sufficient number of equipment is available. Daily practice is also possible when adequate quality of equipment is available to employees for self-training. Many national institutes of public administration in developing countries now purchase microcomputers for training.

In many developing countries, training for users of information technologies is a relatively new requirement. While greater emphasis on user training is being increasingly accorded, in many cases, no specific institutions exist to train users. In some developing countries, the national computer centre is playing a key role and computer specialists are drawn from professional institutions and academic and training centres.

Role Analysis of User-Managers

Any plan to use information technologies requires management commitment. The most successful approach to achieving positive user-managers' commitment involves training which enables user-managers to become aware of their responsibility in information resources management and of the sets of rules and procedures for information resources management to be established in their organizations.

As far as the use of individual information systems is concerned, their benefits are highly contingent on the approach of managers towards their applications in their management functions. Managers must be equipped and motivated to manage information resources as they would any other resource. Unfortunately. many managers still shun their responsibility to properly manage information systems projects. They often allow computer professionals to develop information systems with a minimum of management direction or control. User-managers should manage an information system exactly as they would a system of public works. They must also understand how to deal with a variety of issues raised by the introduction and operation of information systems in their organizations. User-managers' training is thus seen and can be treated as a sensitization programme addressed to senior managers in an organization, in addition to knowledge and infusion of skill training to enable them to develop an appropriate policy in information resources management. This approach led the UN/DTCD to develop an appropriate curriculum for executive training.

Management Needs

The United Nations study, *Modern Management and Information Systems in Public Administration in Developing Countries*,4/ stressed the need for management awareness and knowledge of issues related to the planning and development of information systems. It emphasized the need for commitment on the part of managers and the importance of understanding: (a) the possibilities/limits of computer applications in public administration; (b) the steps necessary for their involvement in information systems development for effective decision making; (c) procedures commonly used in the procurement of equipment and software; (d) organizational impact of information systems development and management (structure, staffing, personnel, training, budget considerations, and maintenance needs); (e) in addition to laws and regulations, senior public managers must also know the basic terminology of information technologies.

TRAINING FOR INFORMATION RESOURCES MANAGEMENT

In applying information systems to management functions, managers have to use technically competent staff and consultants and make a number of decisions with their help. In this connection, information systems planning (ISP) serves as an information catalogue for managers, to let them know where and when to involve themselves in decision making. A formal step-by-step procedure governed by ISP can assist the managers to effectively establish and hence, secure management control of information systems in their organizations. For this reason, an exercise in ISP is emphasized in the United Nations executive training package.

METHODOLOGIES ADOPTED FOR UN/DTCD'S EXECUTIVE TRAINING

Curriculum Design

Out of the above needs and role analysis on senior managers in government, the topics noted below have been identified as essential areas of knowledge and skills which need to be acquired by senior managers. These were actually covered in the Special Appreciation Programme for Senior Government Officials which was held in Stockholm, Sweden, in October 1985, and modified later based on the post-course evaluation exercise, and adopted as basic curriculum for UN/DTCD executive training.

(a) Basic computer literacy;

(b) Application of information technologies in public administration and establishment of priorities;

(c) Management control of information systems;

(d) Laws and regulations; and

(e) Procurement and contracting policies and practices.

Issues in Training Methodologies

Effective presentation of the above topics to the senior managers is the key to the success of executive training. Given five days (perhaps the maximum duration available to the trainees for training/learning purposes, only four days were used; the remaining one day was used for a study tour, sightseeing, and visit to a computer centre; the evening was partly used for individual learning/practice of systems use). The DTCD tried to ensure the effectiveness in training, particularly by taking into account the following issues: allocation of time vis-à-vis top-specific objectives; modular approach; level and number of trainees; quantity and quality of trainers; training materials; use of lectures and examples; use of group exercises, simulation, and games; use of overhead transparencies; use of videotapes; use of study tours/case studies; use of microcomputers (WP and SS); coordination; environment; and use of on-site evaluation.

These issues can be categorically reviewed under two parameters: strategies for organizing training and training/teaching methods.

(1) Organizing strategies

(a) Schedule of topics/objectives

The topics must be relevant to the basic objectives of the training programme. They must be presented in such a way that the participants (trainees and trainers) will understand the intention of the organizers.

The logical sequence of the topics to be presented in the programme must also be evident. In the case of the Stockholm course, the presentation of too many case studies may have somewhat blurred the logical sequence, although the case studies provided a visual understanding of the applicability of information systems to various functions in public administration, as intended by the organizers. It is important, however, to provide sufficient time to each topic. If the schedule is too full, there will be pressure to cut short breaks further and would consequently result in fatigue to participants to the extent that the objective is weakened.

In normal circumstances, executive training can be only possible for one to two days. In unusual cases, such as internationally organized training, senior government officials can possibly be excused from regular duties of their offices, for one week including travel time.

In the five-day United Nations sensitization programme, the above-cited basic themes were given the following duration/weight ratio.

(b)

	Theme (module)	Duration
I.	Basic computer literacy	1 day
II.	Application of information technologies	1 day
III.	Management control of information systems	1 day

IV. Laws and regulations	1/4 day
V. Procurement and contracting	1/2 day
Organizer's interventions, including introduction, conclusion, and evaluation	1/4 day
Optional case studies, observations, and exercises	1/2 day
Break for trainees (trip, etc.)	1/2 day

(c) Modular approach

In the United Nations executive training programme, a modular format is used to organize the course, to accommodate flexibly the busy schedule of senior government officials. The topics can be introduced in the sequence cited above. (E.g., it would be advantageous if the trainees are given basic literacy at the beginning, as the terms are used throughout the training process.) However, if four to five days are not available for the trainees at one time, after the Basic Computer Literacy has been received, they can come back for Themes II-V later, preferably in this sequence.

(d) Coordination

Each training course should be preceded by a meeting of the instructors to tailor the course to the local conditions and specific needs of the target group. This pre-course meeting should be attended by high-ranking officials of the host government, if the course is organized at the national level, to establish the relevance and weight of different subjects in the country to be introduced in the programme. It will also be useful to create a cohesive atmosphere among all involved.

(e) Training environment

Logistics for training is important for the success of the course. Pre-course meeting between the organizer and the responsible person of the host organization is essential in order to secure adequate training facilities and accommodations for executive training. Trainees (executives) would prefer an international environment, as it would more effectively present the obvious comparative perspective, than otherwise.

(f) Use of evaluation

Evaluation of the training programme is an important means of improving its quality, content, instructional methods, and logistics, as well as assessing the performance of the trainers and trainees. The United Nations pilot training course held in Stockholm used evaluation by the participants (both trainers and trainees) on two occasions on site, the first on the second day of the five-day course and the second on the last day. Both were useful, and the results of the evaluation are reflected in the choice of the curriculum as well as the adoption of the training aids, methods, and schedule for the revised training package.

Post-course evaluation by the organizers of the course is essential in improving the programme. At minimum, it should cover, in addition to an overall evaluation: (a) topics, (b) scheduling, (c) the logical sequence of subjects covered vis-à-vis objective, (d) teaching methods/aids, (e) trainees, (f) trainers, (g) materials provided, and (h) environment (including logistics). Such post-training evaluation should be undertaken by organizers and trainers immediately after the course so that they can improve the training package on site.

(g) Trainees/target group

As in the Stockholm pilot course, the particular target group for this sensitization programme will be the senior public managers involved in planning policies and supervising or controlling information systems development in ministries, departments, and public enterprises. They will be line managers at the senior or top level, such as heads of government or agencies, permanent secretaries, or their deputies who would be user-managers of the information systems. Computer specialists and information systems project managers are expressly excluded from this programme. The hierarchical level of the group should be homogeneous.

For each training course, fifteen to twenty participants is an ideal number, taking into consideration such factors as effective dialogue and interaction between trainees and trainers, the number of trainers to be used in the sensitization programme (and the possibility of arranging subgroups of a smaller size), and the number of microcomputers that can be provided at the training site.

(h) Trainers

In the Stockholm training course, the trainers/lecturers had a very high level of competence in their respective fields. Some of them were internationally known experts. The name value of the trainers would attract the trainees and help maintain a high standard in the training course. The trainers should be at least at a senior level so that they can establish effective dialogue with the trainees, i.e., government officials who are also at a senior level.

To maintain cohesive training methods and coordination in presentation and to secure effective instruction by the trainers, the number of trainers should be limited in a five-day course. A limited number of trainers -- three or four in a group of ten to fifteen -- would ensure the availability of trainers for personal consultation with trainees. It will also help maintain a cohesive group atmosphere throughout the course.

(2) Training/teaching methods

(a) Training materials, aids, and techniques

Training materials include reading materials, videotapes, and transparencies for overhead projection. For senior managers, documentation should be limited to key papers only. For a four- to five-day course, the number of technical papers should be limited to a total of 100-150 pages (single spaced). For skill training, computer workshop, group exercises, simulation, and games are planned to be extensively used, as was the case in the Stockholm course.

The UN/DTCD executive training uses the following method for implementing its sensitization programme.

Theme		Aids/Methods
I.	Basic computer literacy	Lectures, exercises microsoft/WP/SS
II.	Application of information technologies in public administration and setting priorities	Examples, lectures, group exercises, videotapes

III.	Management control of information systems	Lectures, group exercises, videotapes, simulations
IV.	Laws and regulations	Lectures, examples
V.	Procurement and contracting policies and practices	Lectures, exercises, videotapes, simulations

(b) Use of plenary sessions: lectures and examples

Lectures are still the major method for conveying a message. For senior managers, presentation of issues should be substantiated with concrete examples. Presentation of issues in a plenary lecture session can be supplemented by group simulation, discussion, and exercises, and can be strengthened by videotape showing and/or the use of an overhead projector.

(c) Group exercises, simulation, and games

Each module in the United Nations executive training programme contains either lecture or group exercise. For the sensitization programme, the small group exercise has been proven to be effective for simulation games mainly used during information systems planning exercises and discussion on specific topics. For the purpose, each group should be composed of four to six participants and one trainer.

Small groups also provide a better opportunity to enhance better relationships among the participants and good atmosphere, and hence, better results. For the four- to five-day course, the same groups can be used for different group exercises to attain the above effects, or they can be changed from time to time depending on circumstances. There should be close monitoring of the group exercises by the organizer. For the purpose, constant meeting among trainers and organizer is essential.

(d) Transparencies

For the Stockholm course, some 200 transparencies were prepared and used for presentation.5/ Transparencies are useful for headlines and explanation of models. It is desirable if the organizer of the course can coordinate the production of transparencies to be used by trainers/lecturers of various sessions.

(e) Videotapes

Use of videotapes can be very helpful. In the case of the Stockholm course, videotapes were used as training aids in several sessions and three of those were made available for trainees. Each of them was 10-15 minutes in length. When they are presented in between talks, it will be effective to break the monotony of lectures and call attention to exemplify the issue under discussion. While study tour is a more powerful method of teaching, 15 minutes of videotape showing can be used rather than a three-hour study tour, depending on the emphasis and nature of the issue in the session.

(f) Study tours/case studies

In the Stockholm pilot course, visits of specific applications (substantive departments), and to a *de facto* national computer centre, were used so that participants had a chance to visualize the demonstration cases of computer applications. A "study tour" is extremely useful for the trainees to get visually exposed to the demonstrative applications. Visual demonstration provides a stronger effect than listening to lectures. If systems application is given great emphasis in the sensitization programme, study tours should be extensively used as in the case of the Stockholm course. However, since the effect of study tours is strong, their use should be assessed in terms of the objective of the training programme, so that the core themes are not blurred by the use of the study tour.

(g) Microcomputer workshops

Actual use of microcomputers is essential for this sensitization programme. Ideally, for the use of word processing and spreadsheet in microcomputers, one keyboard should be available for every one or two trainees. The trainees from developing countries may have never touched a computer in their countries. (To them, a computer is the technician's job, not for such high-ranking officials!) The United Nations course might have given them a rare opportunity to touch the keyboard. In Stockholm, computers were made available during the free time (at night) in the training site at the hotel where the course was organized. It was extremely rewarding for the organizers to have seen these high-ranking officials practicing the spreadsheet (trainers were made available at night), with or without the assistance of these trainers, in the midnight.

TRAINING FOR INFORMATION RESOURCES MANAGEMENT

Among various programmes, it is proposed to, at least, practice the spreadsheet and word processing, as they are more frequently used in offices and easy to deal with. Trainers can choose their preferred software. In the case of the Stockholm course, WRITING ASSISTANT and MULTIPLAN were used for convenience.

NOTES

1/ UNDP Programme Project Management System Enquiry Memory, "Current Project Listing dated 21 May 1987."

2/ Analysis on management of information systems from the United Nations Economic and Social Council, First Regular Session of 1987 (E/1987/38/Add.1), pp. 28-31.

3/ Analysis of major management issues in government information systems and guidelines for effective information resources management were issued in a UN publication in 1987.

4/ United Nations Department of Technical Co-operation for Development, *Modern Management and Information Systems for Public Administration in Developing Countries* (ST/ESA/SER.E/36) (New York: United Nations, 1985).

5/ A hard copy of the transparencies is available upon request from the Development Administration Division, Department of Technical Co-operation for Development, United Nations, New York, New York 10017.

APPENDIX 1. EXTRACTS OF FIVE MODULES FROM UN/DTCD'S TRAINING PACKAGE ENTITLED, "USE OF INFORMATION TECHNOLOGIES IN PUBLIC ADMINISTRATION: A GUIDE TO EXECUTIVE DEVELOPMENT" (NEW YORK: UNITED NATIONS, 1986)

Theme I: BASIC COMPUTER AND COMMUNICATION TECHNOLOGY LITERACY

Objectives

This theme has three objectives:

- to give the participants a minimum basic vocabulary in information technology (computers and communication);
- to stress their role in setting up standards for communication, equipment, and software;
- to give them an opportunity to actually practice on microcomputer software commonly used in office automation.

Main Topics Addressed

1. Basic computer and communication technology literacy
    - why computer literacy is necessary;
    - data processing systems;
    - the parts of a computer;
    - terminals and data communication;
    - programming and systems development;
    - communication systems: telex, videotapes, teletex, PABX.
2. The standard issues concerning information technology
    - why standards are necessary;
    - what kind of standards is necessary.

Lectures and exercises

Lecture I-1 - Basic computer literacy

This lecture aims at providing participants with a basic vocabulary on computers and data processing, mainly:

- the parts of a computer;
- programming and systems development.

Lecture I-2 - Basic communication technology literacy

This lecture aims at providing participants with basic information on communication technology, mainly:

- data communication;
- voice and image (including paper) communication;

Lecture I-3 - Information technology standards

This lecture aims at raising participants' awareness of the following:

- the strategic importance of information technology standards;
- their own role and responsibility in establishing and enforcing standards.

Exercise I-4 - Word processing workshop

This exercise aims at giving the participants some practical experience with basic microcomputer word processing software functions and use.

Exercise I-5 - Spreadsheet workshop

This exercise aims at introducing some practical acquaintance with microcomputer spreadsheet software functions and use.

Practical training recommendations

This theme requires overhead projectors and paperboard as well as a minimum number of microcomputers, to organize the exercises. Thus, depending on the number of available microcomputers, the trainers will split the participants into two or more groups, some of which will do practical exercises on a microcomputer while the others discuss the standards exercise.

The trainers should not be too technical and should not use terms that have not yet been defined for the participants.

During microcomputer exercises, trainers should assume that most participants:

- have never seen a microcomputer. (It would be useful to open one of them to show the various internal components); and

- have never typed on a microcomputer keyboard.

This question of the participants' background should be raised in the preliminary trainers' meeting.

Time Schedule

	Minutes, Minimum	Minutes, Maximum
Introduction	5	10
Lecture I-1	30	40
Break	5	10
Lecture I-2	30	30
Break	15	30
Lecture I-3	30	40
Subtotal	115	160
Introduction	10	20
Exercise I-4	60	90
Break	15	30
Exercise I-5	60	90
Break	5	10
Summing up (optional)	30	45
Subtotal	180	285
Total	295 (4 hours, 55 minutes)	445 (7 hours, 25 minutes)

(Average 6 hours, 10 minutes, not including lunch)

Bibliography

Cohen, Jean-Claude, "Information Technology Skills for Senior Managers."

Statskonsult International, "Overview of Data Processing Technology."

__________ "Why Computer Literacy is Necessary."

Theme II: APPLICATION OF INFORMATION TECHNOLOGY IN PUBLIC ADMINISTRATION, AND SETTING OF PRIORITIE

Objectives

This theme has two major objectives:

- to raise the participants' awareness of the variety of fields in which information technologies can be applied in public administration;
- to stress the need for setting consistent priorities and goals in information system development, at the governmental level as well as the departmental level.

Main topics addressed

1. Application of information technologies in public administration
    - different types of information systems;
    - information systems supporting various functions in public administration;
    - interrelationship between various information systems used in administration.
2. Setting of priorities and long-range planning of information systems in public administration
    - need for priorities and planning;
    - planning methodology;
    - information resources management;
    - information systems and development.

Lectures, exercises, and plenary discussions

Lecture II-1 Information systems in public administration: the state of the art

The lecture will give the participants an overview of:

- different types of information systems;
- various functions they can support in public administration.

Lecture II-2 - Interrelationships and interdependence between information systems in public administration

The lecture aims at:

- stressing the numerous interrelationships between information systems in public administration;
- leading participants to view the whole government as a unique complex system, and its information system as a network.

Lecture II-3 - Information systems planning and information resources management

The lecture aims at:

- introducing the concept and practice of information resources management;
- stressing the need for long-term planning for information systems and specifying the planning method.

Lecture II-4 - Setting priorities and goals for information systems in public administration

This lecture is an introduction to the group discussion and case study which follow. It aims at:

- showing why setting priorities is necessary;
- identifying which kind of priorities should be assigned at the governmental or departmental level.

Plenary discussion II-5 - Development priorities and information systems in public administration

The group discussion should lead participants to:

- identify the development priorities of their countries;
- connect those development priorities to information system priorities.

Exercise II-6 - Setting priorities and goals for information systems in public administration

This exercise leads participants to assign priorities to a subset of proposed information systems projects or proposals, assuming certain priorities in development and taking into account the interrelationships between systems.

Plenary discussion II-7 - Summing up

The final closing session under this theme leads to a summary of the main points covered, namely:

- fields in which information systems can be applied;
- interrelationships between information systems;
- setting of priorities and goals in information systems.

Practical training recommendations

Although the entire theme centres on managerial and strategical issues, it should not be kept at the abstract level only. Trainers should give as many practical examples as possible of the concepts they introduce. Three methods of doing this can be used, alternatively or simultaneously:

(a) choose a variety of examples in developed countries, such as financial management, debt management, or other sectors;

(b) choose existing projects or systems in the host country or neighbouring countries (this requires preliminary information collection and analysis of the state of information systems in the country where the seminar is held);

(c) choose examples of local authorities.

Discussion on local information priorities should be skipped if the topic appears to be too sensitive or conflictual.

Nevertheless, it is essential that senior managers be aware of which level of choices (priorities) is relevant to them in the field of information systems.

The separation between issues of strategic planning and priorities, on one hand, and, issues of project management, such as feasibility studies, on the other hand, is not always clear-cut. There may actually be "fuzzy" areas where strategic choices and feasibility studies are closely related.

Time Schedule

	Minutes, Minimum	Minutes, Maximum
Introduction	5	10
Lecture II-1	20	40
Break	5	10
Lecture II-2	30	40
Pause	15	30
Lecture II-3	15	30
Break	5	10
Lecture II-4	30	40
Subtotal	125	210
Introduction	5	10
Plenary discussion II-5	60	75
Break	5	10
Exercise II-6	120	150
Break	5	10
Summing up	30	45
Subtotal	225	300
Total	350 (6 hours, 50 minutes)	510 (8 hours, 30 minutes)

(Average 7 hours, 40 minutes, not including lunch)

Bibliography

Cohen, Jean-Claude, "A Sample Method for Information System Planning."

Datacentralen, "Terminal Use in Connection with the Financial Management System in the Government of Denmark."

Kraemer, Kenneth, "The Applications of Information Technologies in Public Administration: Micro-computers in Local Government."

National Audit Bureau, "Financial Management and Accounting" (Stockholm).

National Debt Office, "National Debt Management" (Stockholm).

"Payroll and Pension Management" (Stockholm).

Tharnstrom, Kenny, "Public Administration: A System of Interrelated and Dependent Parts" (Stockholm: Statskonsult International AB).

United Nations, *Modern Management and Information Systems for Public Administration in Developing Countries* (ST/ESA/SER.E/36).

Theme III: MANAGEMENT CONTROL OF INFORMATION SYSTEMS

Objectives

This theme has two major objectives:

- to point out to the participants the variety of tasks the senior user-manager must perform prior to the actual development and implementation of an information system;
- to stress the importance of user involvement in system development and the extent to which the senior user-manager can and must control the progress of the project.

Main topics addressed

1. Organization of an information system project
   - definition of objectives of the information system;
   - assuring conformance to present and future systems and to the functions of other administrative bodies;
   - appointment of the project manager;

- defining the responsibilities of the project manager and the steering committee;

- setting up a steering committee.

2. Management control of information system project

- division into tasks;

- time scheduling;

- control (reporting) points;

- milestones;

- adjustment of system objectives;

- evaluation of the final result;

- transition from development to operation;

- maintenance and improvement of the system.

Lectures, exercises, and plenary discussions

Lecture III-1 - Initiation of an information system project

The lecture will stress the necessity for:

- defining and detailing the user goals for the information system;

- assuring relationships and interfaces with other administrative systems;

- defining the environment into which the system must fit and the restraints due to technical, practical, and economic factors.

Lecture III-2 - Organization of an information system project

The lecture will convey to the participants:

- the importance of including all the necessary technical and managerial skills in the project;

- ways of organizing the project with clearly defined responsibilities for each participant;

- the necessity of defining the roles of project participants;
- the important role of the project manager.

Lecture III-3 - Project management issues

This lecture will give the participants an insight into:

- the various ways an information system project can be divided into phases, subprojects, and tasks;
- the responsibilities of the senior user-manager in the review of project plans.

Lecture III-4 - Control of information system projects

The purpose of this lecture is to:

- stress the continuing necessity for the senior user-manager to control the results and progress of the project;
- point out the various ways this control can be exercised;
- stress the senior user-manager's responsibility to stop or delay a project which is taking a wrong direction.

Exercise III-5 - Initiating a project

The exercise will give the participants a specific information system proposal, for which they are to:

- define and prioritize the user goals;
- specify the administrative systems which may need to be involved, either as deliverers of information or as potential users of it.

Exercise III-6 - Time management of a project

Based upon a detailed time schedule for a project, presumably made up by the project manager, the participants will discuss:

- the relevance of the tasks;
- possible tasks not covered;
- the sequence, duration, and overlap of tasks;
- desired control points.

Plenary session III-7 - Summing up

The closing session will lead to a summary of the senior user-manager's role and responsibilities in:

- the organization of a project;
- the control of the project's development and progress.

Practical training recommendations

The theme covers issues of a very practical nature. However, a clear distinction must be maintained between the roles of the senior user-manager and the project manager. Trainers should present the issues on the conceptual level and in a structured manner, and give as many illustrative examples as possible. Presentation of different methods should stress their implications for the exercise of user control, rather than their implementation. The examples chosen to illustrate conceptual issues in lectures and exercises can be a mixture of:

- demonstrative information systems in selected countries;
- information systems already under development in the host country;
- information systems which are about to be initiated in the host country.

The use of examples from selected countries can be useful from two points of view:

- They illustrate the administrative areas where information systems are relevant.
- The description of mistakes encountered in those countries can clarify the issues.

If examples from the host country are used showing systems already under development or being implemented, trainers should be aware of the possible embarrassment to trainees if they have been involved in the systems, particularly if the systems were not successful. Examples of systems which are about to be started in the host country are to be preferred for the exercises.

Inclusion of examples from the host country will require quite a lot of information gathering.

Time Schedule

	Minutes, Minimum	Minutes, Maximum
Introduction	5	10
Lecture III-1	30	40
Break	5	10
Lecture III-2	30	40
Break	20	25
Lecture III-3	30	40
Break	5	10
Lecture III-4	30	40
Subtotal	155	215
Introduction	5	10
Exercise III-5	90	120
Break	5	10
Exercise III-6	90	120
Break	5	10
Plenary session III-7	30	45
Subtotal	225	315
Total	380 (6 hours, 20 minutes)	530 (8 hours, 50 minutes)

(Average 7 hours, 35 minutes, not including lunch)

Bibliography

Mehlmann, Marilyn and Hjort, Goran, "The Importance of Project Management" (Stockholm: Projektstyrning AB).

Sorling, Staffan, "Planning Tools in the System Development Process: SK-80, a Swedish Model for System Development" (Stockholm: Statskonsult AB).

United Nations, *Modern Management and Information Systems for Public Administration in Developing Countries* (ST/ESA/SER.E/36), chapter on management issues.

Theme IV: LAWS AND REGULATION

Objective

The theme has the following objective:

- to give the participants a perspective of the various laws and regulations which may have an impact on the development and operation of information systems in public administration.

Main topics addressed

Laws and regulations on:

- privacy;
- security;
- data transmission;
- tendering and contracting;
- computer crime.

Lectures and exercises

Lecture IV-1 - Presentation of laws and regulations

The lecture will give an overview of areas in which laws and regulations in several countries are today having an effect on the operation and development of information systems. The fundamental background for the different laws in different countries will be addressed, and expectations on coming laws and regulations about to be in effect in the near future will be discussed.

Plenary discussion IV-2 - Privacy issues

The participants will discuss the issues of protection of privacy in their own countries. The existing laws and regulations and cultural background will be discussed, as regards their relevance to information systems.

Exercise IV-3 - Data and systems security

Based upon an example of a system description, the participants will discuss how and where security precautions are relevant.

Practical training recommendations

The theme covers a subject in which there are today very different views internationally. It should, therefore, be covered in a conceptual way, showing with examples what the result of present and future legislation may be.

The trainer should have a chance to analyse the conditions in the host country and use examples of local legislation. However, this could prove to be a big job.

Laws and regulations (as well as business behaviour) in one country having a possible direct impact on information systems in other countries should be dealt with.

The trainer should deal with cultural and political issues in a very sensitive manner.

Time Schedule

	Minutes, Minimum	Minutes, Maximum
Lecture IV-1	30	40
Plenary session IV-2	15	30
Break	5	10
Exercise IV-3	20	30
Closing session	5	10
Total	75	120

Bibliography

Cohen, Jean-Claude, "Government Information Systems Management Laws and Regulations in France."

Freese, Jan, "Data Regulations: The Swedish Experience" (Data Inspection Board).

Institute for Computer Science and Technology, National Bureau of Standards, "U.S. Government Policy Initiative to Improve Security of Telecommunications and Information Systems" (Washington).

Local Authorities System Development Centre, "Protection of the Right to Privacy and the Issue of Making Government Information Public in Japan" (Tokyo).

Morris, John R., "Laws/Acts/Regulations Pertinent to Information System Management in the United Kingdom" (London, National Computing Centre).

Ortendahl, Claes, "Data Processing and National Policy" (Swedish Ministry of Public Affairs).

Qvistgaard, Nils, "The State of the Art in Laws and Regulations Pertinent to Information Systems" (Datacentralen).

Theme V: PROCUREMENT AND CONTRACTING POLICIES AND PRACTICES

Objectives

This theme has two objectives:

- to raise the awareness of senior managers of the need to follow a rigorous series of steps when contracting or purchasing hardware or software;

- to enable user-managers to control the methods of contracting and procurement in their departments.

Main topics addressed

1. General framework for contracting and procurement

   - identification of needs;

   - calls for proposals;

   - invitation to tender;

   - selection;

   - contracting;

- follow-up and reception.

2. Pitfalls in contracting, and the role of senior managers in

- allocation of resources;
- control of procurement/contracting steps.

Lecture and exercises

Lecture V-1 - A general framework for contracting and procurement

This lecture aims at:

- presenting a general framework for the contracting/ procurement process;
- highlighting the role of senior managers in controlling the process.

Lecture V-2 - Selection and procurement of hardware and software

This lecture aims at enabling the participants to control the hardware and software selection and procurement process.

Exercise V-3 - Pitfalls in contracting

This exercise will lead participants to critically analyse an imaginary contracting process.

Practical training recommendations

The trainer should confine the discussion to managerial issues concerning contracting or procurement, not technical questions. Among these should be the specification of needs, the call for proposals, the selection process, and the follow-up.

The trainer will refer as often as possible to Theme III (Management control) and Theme IV (Laws and regulations).

Time Schedule

	Minutes, Minimum	Minutes, Maximum
Introduction	10	15
Lecture V-1	30	40
Break	5	10
Lecture V-2	30	40
Pause	15	30
Exercise V-3	30	40
Total	120	175

Bibliography

Gustafson, Carl Goran and Nilstam, Borje, "Procurement of Computers: The Swedish Model" (Statskonsult).

Sondergaard, Aage, "Selection of Hardware and Software and Acquisition Procedures" (Datacentralen).

PART IV: DEVELOPING AND IMPLEMENTING EFFECTIVE INFORMATION SYSTEMS STRATEGIES

16

INFORMATION SYSTEMS FOR RURAL DEVELOPMENT

Romeo H. Gecolea

Consider these cases in Asian developing countries:

In Country X, it was not possible to determine with any confidence the social and economic impact of a ten-year multisectoral rural development project funded through an external loan of several million dollars. Although the project covered only two small provinces with a population of less than 50,000 families, and despite two socioeconomic surveys conducted during the life of the project, the available data turned out to be inconsistent, discontinuous, and otherwise useless as a basis for any sound conclusions about project results.

In Country Y, the national family planning programme concentrated its resources for many years in creating awareness about contraception and undertaking information campaigns to persuade people to practice birth control. Much later, it was realized that family planning awareness and motivation nationwide has been very high for some time, and that programme resources should have been diverted much earlier from disseminating information to making contraceptives readily available and otherwise establishing the infrastructure for family planning services.

In Country Z, data processed from reports of field workers indicated that a rural health project was proceeding very well. When the project administrator decided to do on-site checks, he found that sickness and death rates in project areas had not actually improved, suggesting that report information was being fabricated by health workers, many of whom did not visit project villages as often as they were supposed to.

These examples should be familiar to those who work with government rural development projects. They underscore problems and weaknesses of information systems in such projects, and suggest areas that must receive emphasis in the design and operation of these information systems.

INFORMATION SYSTEMS FOR RURAL DEVELOPMENT

IMPORTANCE AND FUNCTIONS OF INFORMATION SYSTEMS

An information system may be simply defined as a mechanism for regularly collecting, analysing, and using relevant information as a basis for making decisions on actions to take.

Information is vital to any rural development project from the time it is formulated and on to its completion. Since a project is really an attempt to change an existing state of affairs to a desired one, the project could be doomed to failure even at the conception stage if the data or information used to describe the present state of affairs and devise the strategies to change it are inaccurate or incomplete. Although not all information gathered at the project formulation and appraisal stages may be considered parts of the project's information system (since there is no project as yet), some elements of these must later be incorporated into the system, particularly as baseline or benchmark data.

At the early stages of project conception, formulation, and appraisal, therefore, information performs the function of serving as the basis for the following: (a) defining problems and objectives to which the project will be addressed; (b) developing the strategy to be followed; (c) specifying feasible activities and needed resources to attain the objectives; and (d) setting forth the parameters against which achievement of objectives can be measured.

A project seeks to achieve its objectives by undertaking a largely predetermined set of activities and applying the needed human and material resources over a fixed period of time. As such, keeping close track of the execution of planned activities and the application of programmed resources becomes a key task in managing the project. An information system is therefore needed to perform a second function of monitoring the progress of project implementation in terms of activities undertaken, outputs produced, and money, men, and materials used.

The success of a project is judged on the extent to which it achieves its stated objectives. Such judgements can only be made on the basis of data and information on selected indicators that measure the attainment of these objectives. Thus, a final function of a project information system is the evaluation of the results or impact of the project as envisaged in its objectives.

The above functions of information systems in rural development projects have a common purpose: to provide reliable and timely information on which to base decisions and actions that should be taken. Thus, an information system takes on value only when the information it generates is put to use.

CONTEXT OF RURAL DEVELOPMENT PROJECTS

Government projects that aim to improve socioeconomic conditions in rural areas operate within a context whose features bear directly on the design, installation, and operation of information systems for these projects. The more typical of these features are described below.

1. Information systems are not seen as management tools.

   Ministries and agencies that implement rural development programmes and projects usually have an existing reporting system whereby programme information is obtained from the field. Indeed, field managers and staff sometimes complain of having to spend a considerable proportion of their time in collecting data and preparing various reports for central units. However, these reporting activities are often considered as routine administrative burdens rather than as devices for effective programme management. This perception is not helped by the fact that report data are rarely collated, analysed, interpreted, and, much less, used in programme decision making.

   Until fairly recently, the term "monitoring and evaluation" evoked among government staff uncomfortable images of a malicious management scheme to catch people doing something wrong and then punishing them. This negative perception, together with the undemonstrated worth of existing programme reporting practices, largely explains why the establishment of information systems in rural development projects does not get the attention it deserves.

   The situation has started to improve, with more and more government leaders beginning to appreciate the importance of monitoring and evaluation to good project management, and with development funding donors insisting on building evaluative systems into projects that they fund. Nonetheless, it is clear that those who design projects and information systems have a first task of convincing and educating project leaders and implementers on the uses and applications of such systems. The first design question should be why data are to be collected and processed, not what data and how a computer can process them.

2. Poor human infrastructure.

   In many developing countries, the government is usually the biggest employer. However, when one moves from quantity to quality of manpower, the need for intensive human resource development efforts becomes quite evident. The relatively weak human infrastructure is a product not only of inadequacy in job-related skills and motivation of individual workers, but also of weaknesses in staff supervision and organizational structure.

   The operation of information systems, particularly a computerized one, requires levels of skills, discipline, and organization that cannot be assumed to exist in most developing country situations. These levels have to be worked at, and it is incumbent on system designers to specify the training and organizational arrangements needed to reach these levels.

3. Poor physical infrastructure.

   Compounding the problem of human resources is the inadequacy of physical infrastructure in many rural development project settings. The lack of transport, communication, and other facilities in project areas, and their remoteness from central administrative units that implement the projects, present special problems in field data collection and verification. They pose serious threats to the reliability and timeliness of data fed into the information system. The system designer therefore needs to provide for mechanisms that will hurdle these problems. Indeed, it should be a design dictum never to assume the validity of data that are supposed to flow in the system.

4. Limited budgets.

   Government projects and programmes, except perhaps those funded by external donors, have to operate with very limited financial resources. This imposes low ceilings on the number and quality of staff, kinds of equipment and provisions for their maintenance, and levels of consumable supplies and other operating expenditures. Even donor-assisted projects eventually become subject to these constraints when external funding ends. Information systems in rural development projects should therefore be designed in a way that can be sustained by the implementing agency within its available financial resources.

DESIGNING INFORMATION SYSTEMS: KEY CONSIDERATIONS

The establishment of an information system follows the basic pattern of designing, installation, testing/debugging, and operation. Designing may be considered the most crucial step in the process, as this is the stage when the system's applications, elements, and interactions are specified, and plans are laid out for implementing the succeeding stages. It is most important at this time to take into account the contextual features of the rural development projects described above.

It is unfortunate that nowadays, when one talks of designing information systems, the image that usually comes to many people's minds is that of a microcomputer flashing columns of numbers on its monitor and spewing reams of printout paper. Equating system design with computerization is doubly disturbing when the system in question is intended for use in rural development projects and programmes. For while computerized data processing may be a desirable feature of a system, preoccupation with it may prevent the designer from focusing on other important considerations that will help ensure the workability and usefulness of the system. Some of these key considerations are discussed below.

1. User participation in system design.

   The designer would do well to obtain the maximum participation of users -- the project managers and relevant staff -- in designing the information system. Such a participatory approach offers the following benefits:

   (a) The designer learns more about the substantive content of the project, its information needs, and its present capability for operating an information system.

   (b) Involvement of users becomes a learning experience for them and creates an understanding and appreciation of the value of the system to the project.

   (c) Users who actively helped design the system are more likely to accept and use it, and operate it more competently.

   A useful method of ensuring user participation is to create a task force of manageable size, consisting of appropriate management personnel together with selected project staff who will be responsible for various data handling activities. Where field data are to be obtained from individuals or social units within rural communities in project areas, it would be helpful to secure the involvement of some of their leaders when the data collection part of the system is being planned.

2. Definition of system objectives.

The designer should ensure that there are connections between the objectives of the project and those of the information system. A system objective is well stated when it expresses or clearly suggests how information is intended to influence the implementation of project activities, the application of project resources, or the achievement of project results. If a system objective has no bearing on any of these, it should not be pursued at all.

3. Selection of parameters and measures.

The complexity and cost of operating an information system are determined by the kinds of parameters and data that need to be collected in order to produce the desired information. For example, it will be easier and cheaper to obtain the monthly fertilizer sales of farmers' cooperatives operating in a province than to gather the average monthly income or other data that require interviewing a sample of all farm families in the province.

Given the limited funds normally available for operating information systems, it is important to be very strict in selecting a set of parameters and their corresponding data that can most parsimoniously yield the needed information. There are two temptations that lead to extravagance in selecting parameters and measures. The first is the practice of collecting alternative data for the same parameter or indicator so that each serves as a check on the others. For example, as an indicator of the economic status of farm families, both the gross sales of farm produce and family expenditures on food, clothing, etc. could be collected. Obviously, reducing the number of such alternative data sets would reduce system costs.

The second temptation has to do with computerized data processing. In this case, it is commonly reasoned that since the computer has a powerful capacity to process data, adding one or more data sets does not really matter. Both temptations should be resisted and more "ruthlessness" should be exercised in parameter and data selection in order to yield an economical, affordable project information system.

4. Data collection.

Most of the data that are inputted into a project information system originate or are generated from project areas. It is during the process of collecting such data that threats to accuracy and reliability most often exist. The system designer should therefore ensure that data collection procedures and instruments provide as little room for errors as possible. Some steps that may be taken include the following:

(a) Use well-designed questionnaires and interview schedules for collecting data. Simply giving blank lists or tables of data items to be filled in by sources or collectors of data represents an open invitation for invalid information. It is only in very rare instances that a data collection instrument can assume away the need to use questions that are precisely framed to elicit sound data responses.

(b) Training data collectors/enumerators in the proper use of instruments. Whether a corps of enumerators is to undertake data collection as a one-time or a regular exercise, it is worthwhile investing in a short programme to train them. This is particularly needed when the data to be obtained are sensitive to the methods and instruments used in their collection. A common example are socioeconomic data solicited from rural people who are highly reactive to what and how questions are framed, as well as to the perceived purposes of the questions.

(c) Involve sources of data in the process of data gathering. As mentioned earlier, user participation in system design offers a number of advantages. A similar involvement of data sources in the process of data collection can also contribute greatly to ensuring the reliability of the information and achieving certain economies. When rural communities constitute the major and regular source of needed information, ways should be developed to train and organize them in supplying and even collating data. But quite apart from the resulting quality of information, the participation of rural communities should be seen from the ideological viewpoint that they should be active partners and not passive objects of development efforts.

5. Use of system outputs.

The desired outputs of a project information system are not the data that have been collated, processed, or even subjected to statistical tests. Such data remain meaningless numbers unless they are transformed to real information -- facts and conclusions that result from careful interpretation of processed data and usable for project decisions and actions. The conversion of data to information, and then its actual use in decision making, are often expected to occur automatically once hard data are available. Voluminous reports and tables of numbers which gather dust in many government project offices bear testimony to the falseness of this assumption.

The design of an information system must therefore specify arrangements that take processed data to the stage of information utilization. These arrangements should be addressed to questions such as the following:

- What likely data patterns on key parameters can be foreseen, and what alternative conclusions or decisions would they suggest for the project?
- Who would be responsible for analysing and interpreting data, and preparing reports? Do they need training for these jobs?
- Which project decision makers and implementers should receive reports? Are there relevant agencies or parties outside the project that should also receive them?
- What report formats are to be used, and what logistical arrangements are needed to ensure regular and timely report dissemination?
- How will information be shared with the intended project beneficiaries, e.g., rural communities? What avenues are open to them for influencing project decisions or actions on the basis of this information?
- What feedback mechanisms other than reports can be employed to ensure dissemination of and action on information system outputs (e.g., regular staff meetings to review project progress)?

CONCLUSION

The points made above have sought to highlight the special circumstances in which many rural development projects operate and how these circumstances should guide the design of information systems for these projects.

In this age of computers, there is a marked tendency to think of an information system primarily as a package of data processing hardware, software, and peripherals. But while computers offer us powerful tools for dealing with data, the fact remains that electronic processing of numbers is but one -- and perhaps the easiest -- task in establishing information systems for rural development. Important and crucial tasks lie at the points before and after data are processed: educating on the value of information systems, selecting the parameters to use, ensuring the collection of reliable data, and most vital of all, creating mechanisms for the utiiization of information yielded by the system.

17

DEVELOPMENT STRATEGIES CONCERNING INFORMATION SYSTEMS IN URBAN AND REGIONAL PLANNING

Christian P. Averous

THE CONTEXT

Increasing Demand for Information

The development of the information sector in postindustrial societies is reflected in the results of a survey on trends in the information economy, conducted by the Organisation for Economic Co-operation and Development (OECD). In the early 1980s information occupations as percentages of the economically active population were reaching 30 per cent in Finland, 35 per cent in France, 35 per cent in Germany, 36 per cent in Sweden, and 41 per cent in the United Kingdom. More precisely, in the United Kingdom, for instance, those 41 per cent were the sum of 8.8 per cent of information producers occupations, 24.1 per cent of information processors occupations, 4.3 per cent of information distributors occupations, and 3.6 per cent of information infrastructure workers.

The demand for information, in particular, is growing on the side of the public with the increasing availability of time for the consumption of goods and of leisure-oriented services. It is also growing with the development of "new citizenry": In several countries, for example, environmentalists and consumer groups have gained institutional recognition; and right of information and rights of appeals for the public have been embodied in many administrative procedures relating to, for instance, environmental or consumer protection issues. The need for reliable, scientifically sound, coordinated data and information is today more pressing than ever before, both for the general information of the public as well as for the proper functioning of the technical and political debate.

Changes in Information Techniques

A number of concrete experiments and applications in European cities benefit from technical progress, making economically accessible the treatment of information, the transport of information, and the handling of information and images. In fact, this progress has been particularly stimulated by the advances of telecommunication and computer technologies and more importantly, by the gradual integration of telecommunication and computer applications.

The treatment of information has progressed, notably, with microcomputers enabling relatively low-cost and noncentralized network development, or with smartcards enabling the carrying of files in a very small volume.

The transport of information has progressed as well, with high capacity networks transporting information rapidly and at low cost, with the use of satellites to transmit data, texts, and remote sensing images; and with fiber-optic cabling, permitting the local transportation of large information flows.

The handling of information has progressed equally, with users manipulating simple terminals (keyboards and screens) to be connected to a multiplicity of services, personal microcomputers with extended possibilities of autonomous computation and analysis, or even terminals using video systems. This progress has penetrated local government as well as households and enterprises.

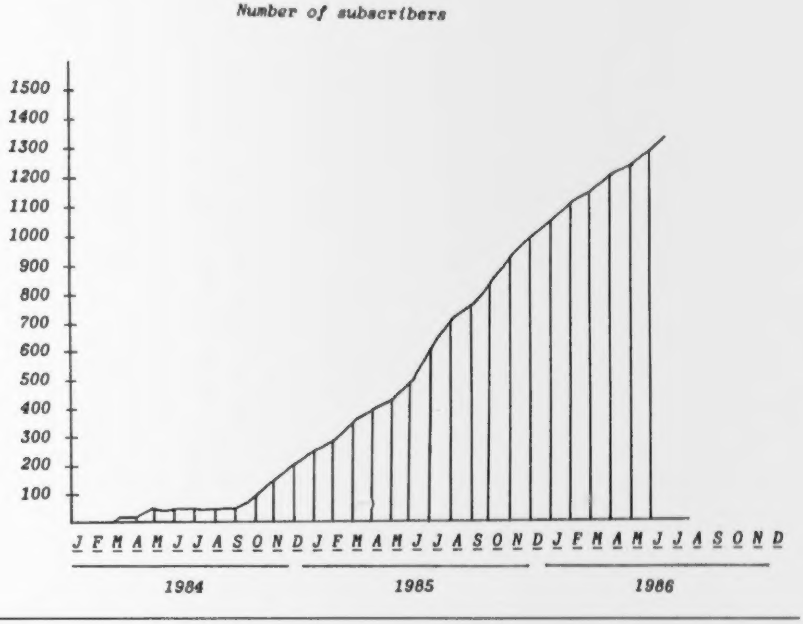
DEVELOPING INFORMATION INFRASTRUCTURES: BIARRITZ

In 1984 an experiment was launched in Biarritz, a southern French city of 30,000 inhabitants. An experimental transport network made of fiber-optic cables was installed and, progressively, 1,500 subscribers were connected (as well as 350 hotel rooms). The network distributes high quality visual and audio services (fifteen television channels: local, national, and foreign; a library of video services; twelve channels of high quality audio); it also makes the interactive exchange of images and sounds between two subscribers possible. For this purpose subscribers are equipped with a terminal (camera and screen) providing TV quality images. Of course, the experimental transport network is connected to the general network and permits access to the general *telephone and "minitel" computerized services.*

Detailed surveys have been made of the use by subscribers of the various services. Household users consume more TV programmes (50 per cent of the users), as many audio programmes

(70 per cent of the users) find the terminal for images/ sounds easy to use and use it either very much or very little; they use it for telephone calls (81 per cent), telephone calls with image (46 per cent), calling city information systems and other data banks (50 per cent), but little for the transmission of images of documents or objects (6 per cent). It is clear also that the still small number of connected subscribers limit the use of the terminals. Professional users respond to more precise needs: they transmit more images of text and object, and use more data bank interrogations. Applications in the medical, educational, and banking professions are to be mentioned.

Figure 66. Number of Subscribers



DEVELOPMENT STRATEGIES

Changing Urban and Regional Policy Priority Issues

Several trends in Europe have significance for the development of information systems:

- The rapid urban population increase of the 1960s and 1970s has given place to a stagnation of urban population; consequently, earlier priorities on building and infrastructures provision are replaced by priorities on the management of urban services more dependent on information systems;

- Changing patterns of population migration have resulted in the growth of small- and medium-sized cities, while in larger cities there often is a concentration of declining industries and disadvantaged groups. This movement has intensified the imbalances between growing and stagnating urban areas. This trend is due in part to the fact that older industrial cities have inherited the infrastructure, physical layout, and economic structure of another era. The adjustment process is more difficult in these cities. In addition, as the growth sectors in most OECD countries such as communications and electronics are footloose, and their employees tend to be highly educated or skilled workers, enterprises locate where these people live or want to live. Location decisions are not based on traditional factors of cheap labour or even taxes, but upon the quality of life, including climate, physical amenities, and cultural and educational facilities. Older industrial cities are increasingly developing information and communication policies to change their "image" both for their citizens and to attract new enterprises; and

- Sociodemographic changes lead also to a marked increase in population groups requiring particular service provisions and amenities; for instance, the high increase of elderly in urban areas as a percentage of the total urban population, and the growth in the number of children whose parents are working as a consequence of the growth of women in paid employment.

Economic Situation and Funding Limitation

The general economic situation has become a key determinant for the choice of strategies for the development of information systems in European cities and regions. This economic situation is characterized by:

- Limited economic growth in most countries, leading to a lack of resources for state and local authorities;

- A consequent search for effectiveness and efficiency in investments and in the functioning of state and local authorities, including the development and improvement of the urban and regional information systems aiming at a better allocation of resources;

- Competition to attract enterprises among cities, regions, and sometimes countries; and

- A consequent search for the creation of employment in sectors relating to new technology (e.g., information, biotechnologies) and sectors relating to quality of life and leisure-oriented services (e.g., amenities, amusement parks, sport and health facilities, tourism facilities and services).

STRATEGIES FOR THE DEVELOPMENT OF INFORMATION SYSTEMS

Trends in Europe

The use of information systems by local authorities in Europe has grown steadily and has now become quite widespread, although small towns and rival municipalities are often still only beginning to use information systems.

This experience shows that a major danger is to superimpose information systems upon the existing organization without a clear understanding of the purposes that the information systems must serve. The result can then be the presence of heavy, centralized, and separate information systems which are very costly and difficult to transform; alternatively, a multiplicity of scattered and unmastered applications give only a feeling of modernization. The result can also be the coexistence within the same administration of a modern and an archaic sector without significant global gains in cost-effectiveness. In summary, information systems are not ends but simply means to achieve some priority objectives for cities or regions. Therefore they must be seen as tools to satisfy these objectives. Although this is commonly accepted today, it is not sure that in practice this principle is always applied or even easy to apply.

The introduction and present development of information systems have obeyed or should obey two driving objectives:

- To increase the effectiveness and efficiency in urban and regional planning; and

- To contribute to urban or regional development.

The first objective has dominated the introduction of information systems in the 1970s in Europe and has been supplemented in recent years by the second objective in a number of cities, reflecting the contextual changes described above.

Increasing the Efficiency and Effectiveness in Urban and Regional Planning

More precisely, the introduction of information technology in local government in Europe has responded to concerns with improved efficiency and effectiveness. It has progressed stepwise with the computerization of routine administrative tasks making use of voluminous files, with fairly repetitive processing operations such as personnel management (e.g., payroll, holidays, pension), accounting tasks, population records (e.g., voting registers, births, marriages, and death records), payment of welfare benefits, the local tax support system, and further with the use of by-products of previous applications (e.g., instant budget states) as a local management tool. Progress has been made with the integration of various applications into "municipal information systems" to satisfy not only local and specific managerial needs but also short-term decision making and planning tasks: Financial information systems, population information systems, and physical informations systems are examples. Concerning medium long-term planning, applications have focused on the development of models and on building up data banks for planning; this particularly concerns actions relating to urban planning, housing transport, and the environment. These types of applications are presently extending to socioeconomic services such as childcare and educational, health, safety, and cultural services.

The overall objective of improved efficiency and effectiveness necessitates referring to two functions of information systems:

(1) To improve the factual knowledge of local situations (e.g., land-use and cadastral information, demographic information, economic and fiscal information, environmental monitoring) and to report on this knowledge; and

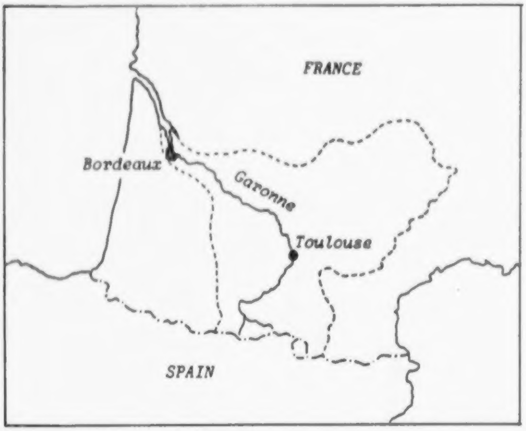
(2) To contribute to the development, implementation, and assessment of policies and actions. This applies to the daily management, the yearly budgeting process, and

the medium long-term decision taking in the context of improved anticipation of future situations.

FLOOD ALERT SYSTEM: THE GARONNE BASIN

The Garonne Basin extends over 115,000 km^2 in southwestern France. Owing to local geological, topographical, and climatic conditions, the Basin is subject to frequent sudden and violent floods. Floods of catastrophic proportions have been experienced for centuries and have occurred in 1952, 1977/78, and 1981. The economic cost is high. A flood in 1977/78, for example, cost over Fr 320 million (US$34 million in damage to agriculture, industry and trade, personal property, roads and public buildings). In this context, flood forecasting and early warnings are essential in order to limit the damage.

Figure 67. The Garonne Basin



The old system of forecasting floods and issuing warnings was based on measurements made by observers, sometimes volunteers, and the transmission of information and warning messages by telephone or telegram on an individual basis. This system became less reliable and less rapid with falling populations *in rural and mountain areas and changes in the conditions of telecommunications management. Recent technological progress in microelectronics, teleprocessing, and telephone networks has made it possible to design a more highly automated and more efficient system.*

The authorities introduced recently, therefore, an automated system for measuring and transmitting hydrological and meteorological data and a special risk warning system to inform the local authorities and populations concerned.

The first system, for the automatic measurement and transmission of data, comprises 120 automatic observation stations that can be interrogated hourly and which send hydrological and meteorological data via sixteen radio links to a control centre in Toulouse. All of the data, which are collected in less than six minutes, are processed and then transmitted according to local needs to the bodies responsible for forecasting and issuing flood warnings. These bodies are thus able to produce within a very short period flood risk forecasts of a better quality than those hitherto available, and to prepare warnings in advance of any decision to take action. The Garonne Basin automatic data measurement and transmission system cost an estimated Fr 30 million (US$3 million).

The second system enables the bodies responsible for forecasting to issue flood warnings very rapidly to the departmental authorities. These authorities alert local mayors, who in turn alert the population. This system uses the telephone (the public network), facsimile transmission, and radio transmission. It will shortly be modernised by introducing a special risk warning telephone network. It is planned that this new type of flood warning system will be extended in the future to cover more French drainage basins.

Contributing to Urban and Regional Development

In the 1980s a number of municipalities have adopted a wider strategy relating to information systems. Not only do they aim at cost savings and increased effectiveness in their management and decision making, but they see information systems as a key to their own development and therefore actively support the development of activities relating directly to information systems.

DEVELOPMENT STRATEGIES

Local authorities can contribute to the expansion of infrastructures which transport information, by investing in local cable networks, and by connecting better to national and international networks; often joint financing is required involving public as well as private funding, local as well as regional and national funds.

Local authorities can also contribute to the expansion of information based services for the public and enterprises. The introduction of specific information services (e.g., emergency safety, health information systems, possibly addressing specific groups (e.g., the elderly, the young), the introduction of smart cards for the payment of local services (e.g., public transport), and the provision of administrative information and local meteorological information to citizens and enterprises are examples.

Local authorities can decide to attract information-related industries such as microelectronics or telecommunication firms. This can involve the following actions:

- Fiscal and other incentives;

- Creation of information technopoles to benefit from and stimulate intellectual and research local assets;

- Providing information-related services to small- and medium-sized firms; and

- Strengthening or changing the image of the city through proper advertisement and media-based campaigns.

In progressing in this way there are:

- Risk of competition between cities for new technology and related jobs is tough; not all cities will successfully become new information technology developments (e.g., controversy on the degree of use of fiber-optic cabling vs. conventional cabling); and

- A need to coordinate the provision of the infrastructure and the stimulation of both the demand for information services (particularly through the equipment of household and firms in corresponding terminals) and the supply of information services through the proper mix of public, private, and nonprofit organization efforts. Successful examples such as the Minitel experience in France have demonstrated this need.

THE MINITEL EXPERIENCE IN FRANCE

The experience known as "Minitel" was launched in France with two experimental cases in the city of Velizy (1979) and Rennes (1981) and has been progressively extended to the whole country since February 1984. Terminals (keyboard and screen) are provided to households and use the telephone line to connect through a network of information transporting routes to a number of computerized serving systems. At the beginning of 1985 1.6 million calls/month were registered, at the beginning of 1986 8 million calls/month, at the beginning of 1987 the figure of 20 million calls/month had been reached. Today 2.5 million terminals have been requested and distributed free to households; about 80,000 additional ones are distributed every month.

The number of serving systems now reach more than 4,000 and are identified by code names in a registry book. The most popular of these serving systems can be grouped under the headings: services, games, electronic mail. The first heading covers a wide variety of services:

(1) Consultation of the "electronic" telephone book, consultation of practical administrative information provided by city administrations;

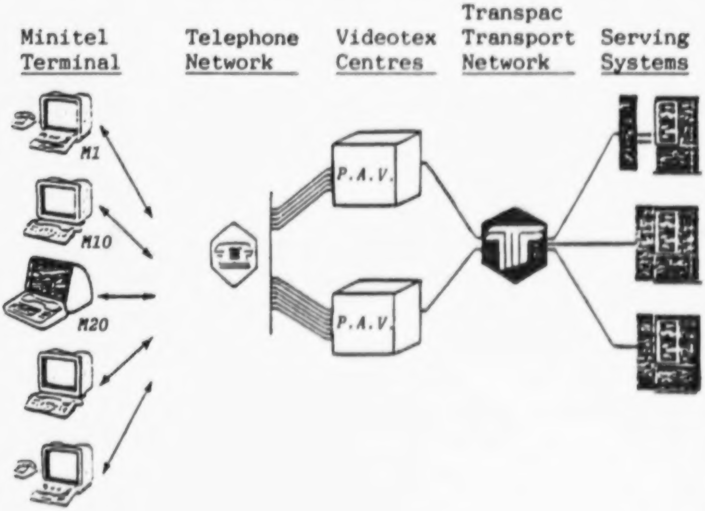
(2) Information services: for instance, most of the newspapers provide information such as major news, stock exchange, housing ads, meteorological news, a registry of programmes of cinemas, theaters, concert halls, exhibitions, and prognosis concerning horse races and soccer games. For instance, 150 banks provide information on the status and recent fund movements on people's accounts; some further allow transfers among accounts, management of portfolios, etc.;

(3) Information and reservation services (e.g., air, train, road transport companies, hotel rooms, tourism agencies); and

(4) Presale information/order/after-sale information for many companies selling "by mail"; new services have also been created to do the daily/weekly shopping by taking orders and delivering to the

home.

Figure 68. Scheme of the "Minitel" System


Minitel Terminal
Telephone Network
Videotex Centres
Transpac Transport Network
Serving Systems
M1
M10
M20
P.A.V.
P.A.V.

Games are proposed and played by the young and the less young. They include games of amusement as well as intellectually challenging games of strategy and thought. They are often offered by newspapers or radio/TV channels. The educational games extend to educational services with tests classified by level of class and discipline (language, spelling, scientific, history, geography) and with SOS services to help overcome some homework difficulties with a twenty-four-hour delay.

Further, electronic mail services have helped respond to the need to communicate in cities. After a boom in "convivial electronic mail," more specialized and service-oriented electronic mail services are now developing. Electronic mail has also played a promotional role in the diffusion of the Minitel system.

Opinion surveys among users show largely positive attitudes towards the terminal and its use (88 per cent and 83 per cent satisfied, respectively). Two-thirds of the users are less than forty years old, one-half of the users belong to households of professionals. About half of the terminals are used only once a week; the success of games and electronic mail is due to a minority of users (6 per cent of daily users); but the already important use of many practical services and their continuing growth in number and use show that the development of the Minitel system has caught its second wind.

The increase in traffic is reflecting both the increase in the stock of terminals and the increase in the number of services offered. During the month of February 1987, a total of 4 million hours of connection was recorded. Although the most highly used service is the electronic phonebook which is free for the first three minutes of consultation (17 per cent of the traffic), the large majority of the traffic (60 to 70 per cent) corresponds to priced services where telephone connection and services are priced. This latter traffic generated Fr 720 million for those offering the services during 1986. A minority of the traffic corresponds to "unpriced services" where only the telephone connection time is paid.

IMPLEMENTATION ISSUES

Cost/Benefit Analysis of Information Systems

Decisions on information systems and information technology have often been based on faith. The design and use of information systems should be based on a much more careful analysis of costs and benefits, both financial and nonfinancial, and of risks, than currently exists.

In order to reduce costs, sharing experience should be developed among local governments. This is workable and allows a more rapid growth of information systems use. However, sharing experience may be inhibited by self-interest, bad experience, lack of opportunity, and budget constraints. It is usually considered that for small towns the cost of information systems is between 0.5 and 3 per cent of the operation expenditures, or about 1 per cent of the total budget of the local authority. Another estimate leads to about US$10 per inhabitant in the first year and US$2 per inhabitant in subsequent years. Cost is not a major obstacle anymore to the introduction of information systems.

On the benefits side, reduction in the number of office staff has slowed down recruitment; in other words, more work is done with the same total staff. Some cities have calculated benefits derived from specific applications, such as improving cash position by collecting electricity bills sooner, or by better management of supply stocks. Indirect benefits from improved management and decision making, and from time saved from routine administrative tasks for professional staff should be assessed, as well as risks related to possible levels of failure of the system.

However, the major negative effects might be incurred because of resistance to the implementation of information systems, and major positive benefits can be obtained if the information systems contribute directly to a more effective administrative organization.

Progressive Implementation of Information Systems

The effects of information technology on individual tasks can be enhanced by progressive and adaptive implementation maximizing the benefits and minimizing the adverse effects. This requires a design of information systems with an awareness of their potential and limits and the need to adapt them to the human context.

Operating personnel tend to receive information technology well; they readily perceive improved processing speed, capacity to deal with more complex cases, and time saved for other tasks. However, coding tasks should be spread among personnel, and a short initial period of adaptation is necessary.

Management staff tend to perceive data processing as a progress enabling them to devote less time to routine tasks, and to have at hand a tool responding better to managerial functions. It is important to develop management-oriented services and to start with motivated officials or offices before spreading the system to other offices.

Elected decision makers often perceive information systems in terms of their costs when voting the budget, and related to an image of modern management in terms of community prestige. More awareness of the limits and potentials of information systems, with respect to decision making and with respect to the structure and organization of local governments, would be needed.

DEVELOPMENT STRATEGIES

An Opportunity for More Effective Organization

The effects of information systems on local government organization can be seen as both an opportunity for more effective organization and a mechanism to reveal potential conflicts. It is essential to consider them as a tool to achieve a more effective organization, and to design them as such. Intensive consultations before and after implementation with user services are crucial in this context.

It is not clear whether data processing will contribute to centralization for the benefit of the data processing department and the city decision makers (as is often argued in relation to the use of main computer frame), or will contribute to decentralization (as is often argued in relation to the introduction of microcomputing units). The answer, probably, is that the tool is fairly neutral in itself and that the impact will depend largely on how the tool is implemented and used.

Assistance and Maintenance

Whereas technical complexity was an obstacle to information systems development in the 1970s, the fast progress in the quality and quantity of software has led to much easier and decentralized dialogue between users and information systems.

Attention, of course, should be given to possible breakdowns of computerized information systems and the related paralysis in the provisions of major public services to important population segments. Breakdowns are not specific to information systems, but highly integrated and automated systems may be more vulnerable to such disfunctions. Information systems are a new infrastructure within cities and require sufficient protection, as any other infrastructure does.

As a consequence, technical assistance and maintenance remain major concerns, but computer departments are not the only masters of the process and technical constraints are not as critical as they used to be.

Training

A major concern for local government is training. Towns allocate time and money to training which do not always seem adequate. The training provided by manufacturers should be supplemented by proper instruction within general education, and by national agencies dealing with information technology, and/or urban and regional planning. There is a role for national and international institutions to provide and/or support training courses concerning information systems. It is likely that the problem will become less acute when information technology ceases to be a new technique and is widely taught as part of general education.

Past experience suggests that:

- Operating staff should receive technical instruction less oriented towards a particular brand, which would facilitate change of equipment and decrease dependence on the manufacturer;

- Heads of data processing departments often need to learn about the local government, its structure and power, and urban and regional planning needs;

- Administrative personnel should receive a less technical training focusing on the constraints and potentialities of information technology and on communication with the data processing department; and

- Decision makers should be in a position to decide on computer identification for management and decision making.

Privacy Protection

Privacy protection also requires attention, although it has not proven to be a serious problem yet. The technology provides a great variety of facilities for preventing access to confidential information by nonauthorized personnel and users. They include software controls such as passwords and access codes, physical admittance restrictions by means of guards, locks, and identification cards, as well as administrative procedures including identification of secrecy levels, i.e., who should be allowed to have access, and controls on the provision of information to authorized users. National governments have to provide proper legislation and regulations concerning the safeguarding of confidentiality of sensitive data kept or used by urban and regional authorities.

A more recent concern relating to privacy protection has arisen with the increasing penetration of data banks and information systems within the home; as a new media, comparable to radio and television, they require adjustments to national and/or local regulations.

Technical Quality of Data and Information

The technical quality of data and information requires special efforts to better collect, treat, analyse, and express data and information.

Aside from progress with conventional data collection mechanisms such as census surveys, use of administrative files, and aerial photographs, new techniques are being used, such as remote sensing. Landsat, Spot, and future earth observation satellites, with proper computer treatment of the information, provide data and image products. With its good level of resolution, its independence from administrative boundaries, and its relatively low cost, remote sensing is particularly useful for problems relating to land-use and vegetation cover, zoning, and a number of other urban and regional planning concerns.

REMOTE SENSING

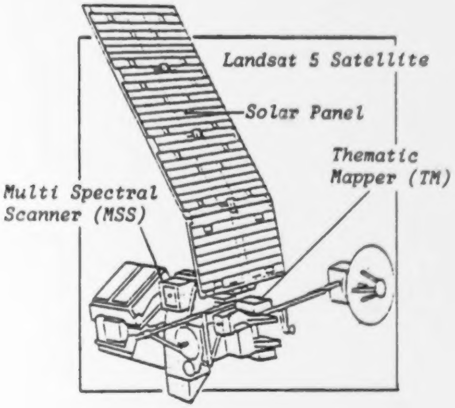
Remote sensing comprises the collection of physical data concerning the surface of the earth and its cover and environment, as well as computer processing and interpretation of these data leading to image products or data products.

Data are collected from observation platforms such as satellites which carry passive or active sensors. Remote sensing from space offers more advantages and is more satisfactory in operation than aircraft methods because of the quasi-instantaneity of the recordings and the standardization of the data acquisition in processing methods. Presently the Landsat and Spot satellites provide most of the data for the urban and regional planning studies. Each user can obtain standard products in receiving stations in black and white or in false colour and magnetic tapes.

Digital processing of the tapes can take three possible forms: Production of enhanced false colour images for interpretation; performance of arithmetical or logical operations; automatic classifications known as nonground truthed or ground truthed processing. Multidata analysis can be done also.

This technique has been used in a number of studies at the urban planning level: land-use and land cover maps and statistical tables have been produced in urban

Figure 69. Landsat 5 Satellite



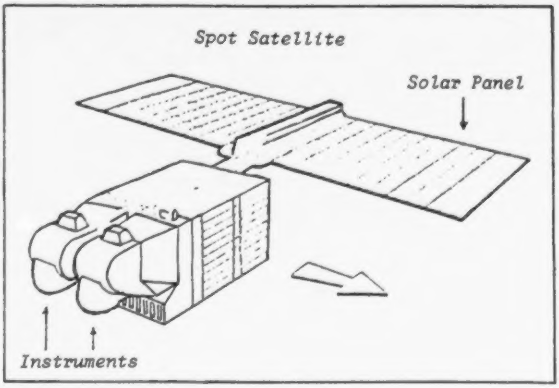
regions and helped to review changes of land-use over time (e.g., at three- to five-year intervals); vegetation density in urban regions can be estimated by use of a biomass index and mapped; zoning of housing density and age as well as vegetation cover has been done in a number of cities; imperviousness has been estimated in urban areas by watersheds and administrative units; and heat losses by buildings and networks have been identified during winter.

This technique has also been used at the regional planning level. The following are selected examples:

- *Land-use and development: Mapping and statistics concerning land-use and coastal zones, changes in land-use, soil suitability and agriculture potential maps, erosion risk maps, maps showing plant cover and relative importance of green biomass, site selection for building large structures, evaluation and follow-up of the impact of major works;*

- *Forests: Mapping of major types of forests, locating disease and insect attacks, monitoring the effectiveness of treatment, estimating potential wood production, deforested areas and regeneration, determination of areas sensitive to or endangered by human pressures and activities, monitoring of fires and evaluation of fire risks; and*

Figure 70. Spot Satellite



- *Water resources: Inventory and mapping of water surfaces, areas prone to flooding, limits between fresh and saltwater, turbidity and movements of sediment, assistance in site selection for reservoirs, canals, flood channels, and dikes, mapping of surfaces covered with snow or ice, dispersion of pollution in estuaries and along coastlines, locating accidental coastal oil pollution.*

Remote sensing techniques, because of their relatively low cost and their independence from administrative boundaries, are becoming essential supplements to traditional data collection techniques and integral components of information systems.

As mentioned earlier, data transmission, treatment, and analysis have progressed in quantity and quality with the development of transmission networks, of microcomputers, and of related software, allowing better access to data and more interactive data handling. Several attempts have been made to improve the readability and expression of data. Aggregate indices and indicators have been developed to present data in more understandable ways. Graphic expressions of data also contribute to readability; advances in information technology enhance this readability of data for the public. Proper communication means are essential: conventional ones such as newsletters and newspapers, audiovisual products and advertisement, as well as new ones such as interactive systems. However, information expression always requires careful attention to presenting data in an understandable way, avoiding misleading interpretations.

Informing the Citizens

Information technology brings direct benefits to people by improving the delivery of a number of city services to users. These benefits include:

(1) A simplification of administrative formalities through reduction in time spent completing forms; improved speed and reduced waiting time in the delivery of routine documents and operations; reduction in the number of errors and related complaints; provision of choice in the modalities of payment; the introduction of "smartcards" will also simplify a number of administrative transactions;

(2) Better information for the public; examples are: routine information on urban conditions such as weather or pollution information and forecasts, as well as periodic urban reports or white papers on key aspects of the state of the city; and

(3) A more informed participation of the public in decision making processes; one example being the voluntary adaptation of travel patterns to traffic conditions monitored and reported by radio, or anticipated and reported by press, radio, and TV; another example being the participation of the public in procedures of environmental impact statements.

INFORMATION SYSTEMS ON THE QUALITY OF BATHING WATER IN THE EUROPEAN COMMUNITY

The Council of the European Communities' directive of 8 December 1985 has established the standards of water quality for beaches and other bathing areas. The implementation (measurements and analysis) has to be organized by member countries usually through the subregional offices of the relevant ministries. This is especially important because of the massive touristic use of coastal areas in the summer seasons.

For example, some 20,000 analyses are made every year in France between the 1st of June and the 30th of September. In 1985, some 1,500 points, beaches, or bathing areas, with measurements made on average every week, have been monitored in 530 communes of the twenty-five coastal prefectures. Similar programmes exist in Spain, Belgium, and the United Kingdom.

The analyses are performed by local laboratories and the results of these analyses, together with comments concerning the local situation and the interpretation of the results, are transmitted to the local mayors of the communes. These results are made locally available to the public through display on the beaches, in the local tourism offices, or in local newspapers; they are also accessible by telephone calls to the subregional health authorities.

When the results show that bathing waters are approaching or exceeding the authorized standards, further investigation, including additional sampling, is made, often on new parameters. When it appears that the bathing waters are polluted, the mayor is requested to close the beach or bathing area affected.

At the end of the summer season, an overall report is established by each subregional office on the situation which contributes to shape the proposed waste water treatment projects and the permit allocations for waste water release by individual firms or local authorities. This report helps also to define priorities for the overall waste water treatment schemes and to provide orientations for the local authorities' action concerning the rehabilitation of contaminated bathing waters.

At the national level every year, a statistical assessment is published and a classification of bathing areas is made according to the four-class scale, providing a national picture of the situation. Coloured maps and diagrams are made available. In recent years they have contributed greatly to the wide dissemination of results through the local and national media, including the major TV networks, thereby ensuring a very high public visibility of the results, and enabling tourists to make better choices on their places of vacation.

Generally speaking, the data publication/dissemination stage has been less developed than the measurement and the data processing/analysis stages. A great deal of information remains unpublished and is kept inaccessible to the public; and the transparency of information is often not yet appropriate to fill the public's "right to know." It often seems appropriate to enhance data publication/dissemination to accomplish more effective use of data -- and this at a cost which is comparatively lower than that of the measuring and processing/analysis stages.

Role of National and Local Governments

Usually local authorities would rather invite national government participation. This is because costs and risks of experimentation are typically too high and expertise is too difficult for a single local authority to obtain and keep. Local authorities expect national government to provide a consistent and coordinated legislative framework, policy guidance, as well as programme and project activities because of the national financial resources attached to them.

Further, local authorities may want to cooperate together to avoid wasteful duplication of work, and also to maintain some degree of autonomy from central authorities or large cities for instance. This cooperation can take the form of an exchange of information (e.g., mechanisms of financial aids, municipal actualities, changes in regulations and administrative structures) or of an exchange of experience concerning information systems (e.g., software development).

Finally, the cooperation between local authorities and other local actors such as enterprises, universities and research centres, and nonprofit organizations is essential with respect to the objective of contributing to urban and regional development through an active communication policy.

A Local "Communication" Service

Traditionally, local authorities have played an important role in the provision of educational, water, transport, health, social, and cultural services. In Europe, there is also an emerging local "communication" service in which local authorities play a leading catalytic role through education, information, and advice, through subsidy and financial support, and through investment in infrastructures (cable networks for instance). Local governments are well placed to play a major catalytic role in the advances towards an information-oriented society, and in the stimulation of related benefits of the economic, social, and cultural development for the region.

There are a variety of emerging institutional arrangements in Europe where, usually, the private sector (enterprises, households), nonprofit organizations (e.g., associations, universities), and the public sector (public enterprises, regional and national administrations) interact and play roles. The role of local authorities in this context is not always spontaneous, nor indispensable; private organizations (e.g., chambers of commerce, regional press) may take the lead. However, local authorities have a specific role, providing a number of services aimed at animating local life and at valourizing local resources. Further, they often are best placed to orchestrate the development of information systems with the participation of many local partners, producers, and consumers of information.

Some cities have further engaged in information strategies to associate local research and intellectual institutions and private firms dealing with information hardware and software, and to foster concentrations of high technological activities in science parks and technology complexes. Such efforts aim at the general economic stimulation of the area, including the raising of the tax base and the provision of jobs. The drive to establish parks has been reinforced by the better exploitation of some underused assets such as land or buildings, and the enhancement of academic repute. A renowned research/intellectual institution, an enthusiastic group of leaders, and good environmental and cultural amenities seem to be necessary conditions for success.

The challenge for local authorities thus goes much beyond the development of a public information system and encompasses the development of information infrastructures (e.g., local cable networks, connection to national or international telecommunications systems), the stimulation and channeling of new local media (e.g., interactive information systems), and the provision of conditions for the development of an information-based sector in the local economy, leaving a major role to private and nonprofit organizations.

THE KARLSRUHE TECHNOLOGY FACTORY

The Karlsruhe Technology Factory was born in talks between the University of Karlsruhe (training more than 60 per cent of all German students of information technology), municipal authorities of the city of Karlsruhe, and the Chamber of Trade and Industry of a *region which is hosting thirty-two scientists per 1,000 industrial employees, many research institutions, and high-tech firms.*

The Karlsruhe Technology Factory works as a partner with other major research and development institutions, and is an organisation addressing particularly young enterprises. It specifically:

- *Promotes the utilization of spin-offs from activities undertaken by universities, research institutions, and industry;*

- *Provides enterprises in this region with a comprehensive set of technical and business management services;*

- *Acts as a regional information centre for all technological problems; and*

- *Together with its partners, supplies and develops concepts for further training in fields related to new technologies.*

After two years of operation, the Karlsruhe Technology Factory housed a large majority of new enterprises active in the field of information technology and microelectronics, and was playing a unique role in stimulating the commercialization of knowledge and information technology within the larger context of the Karlsruhe high-tech and intellectual complex.

CONCLUSIONS

The penetration of information systems into urban and regional planning has to be placed in the context of increasing demands for information, of changing telecommunication and computer technologies, of changing urban and regional policy priority issues, and of economic constraints on employment and public spending.

The use of information systems by local authorities in Europe has grown steadily. This growth follows two strategies of development. The first and most widespread strategy aims at increases in effectiveness and efficiency in urban and regional planning through the computerization of administrative tasks and through the support of decision making by information systems. A second supplementary strategy was more recently adopted by a number of cities: It aims at contributing, through the information sector, to urban and regional development.

The three major obstacles to the development of information systems identified in the 1970s are being resolved: Financial expense has largely been overcome with reduced costs in computing and telecommunications; technical complexity has largely been overcome with the development of user-friendly software and systems. This leaves personal adaptation and organizational obstacles as the main problems to solve. In other words, the limits are becoming less technical or financial and are increasingly related to proper training and more effective organization, as well as to the proper adaptation of information systems to the above-mentioned objectives.

The utilization of information techniques at the local authorities' level raises a number of implementation issues relating to: the cost/benefit analysis of the investment in information systems, progressive implementation, assistance, and maintenance, privacy protection, and the technical quality of data. It also relates to efforts to bring the information to citizens and other users, and to the role of national and local governments in sharing responsibilities between public, private, and nonprofit sectors. Local authorities can play a major catalytic role in stimulating the development of local "communication" services for enterprises, administrations, and the public, and thereby the economic and cultural development of the area.

REFERENCES

Freeman, Howard E., Rossi, Peter H., and Wright, Sonia R., *Evaluating Social Projects in Developing Countries* (Paris: Development Centre, Organisation for Economic Co-operation and Development, 1979).

International Bank for Reconstruction and Development, "Learning by Doing: World Bank Lending for Urban Development, 1972-82" (Washington, DC, 1983).

Mohan, Rakesh, *Urban Economic and Planning Models: Assessing the Potential for Cities in Developing Countries* (Baltimore: Johns Hopkins University Press, for the World Bank, 1979).

Organisation for Economic Co-operation and Development, "An Exploration of Legal Issues in Information and Communication

Technologies" (Paris, 1983).

______ "Information and Natural Resources" (Paris, 1986).

______ "Local Government and Information Technology" (Paris, 1978).

______ "Managing and Financing Urban Services" (Paris, 1987).

______ "Microelectronics, Productivity and Employment" (Paris, 1981).

______ "Policy Implications of Data Network Developments in the OECD Area" (Paris, 1980).

______ "Trends in the Information Economy" (Paris, 1986).

______ "Urban Environmental Indicators" (Paris, 1978).

United Nations, "Human Settlements Performance Standards" (New York, 1977).

______ "Indicators of the Quality of Urban Development" (ST/ESA/56) (New York, 1977).

United Nations Centre for Regional Development, *Information Systems for Urban and Regional Planning: Asian and Pacific Perspectives* (Nagoya, 1986).

18

DESIGNING AND IMPLEMENTING INFORMATION SYSTEMS STRATEGIES

John Lindsay

INTRODUCTION

The planners' use of information has been discussed in detail in a number of papers.1/ These tended to deal with information at the level of published sources and the operation of planning practice. They did not deal with the idea of designing information systems. Discussion of information systems design for planners received attention for a period in several countries,2/ but they appeared to set tasks which were beyond the level of the technology to support it.

There is now a renewed interest and the emergence of a literature dealing with information systems design for urban and regional planners, with a particular reference to the situation in developing countries.3/ It is also now recognized, probably without argument, that the facilitator for this discussion has been the widespread availability of the microcomputer.4/ The focus of the discussion into this thrice specified domain has possibly hidden some lessons which might be learned from other parts of the world of information, of systems, and of design. The awesomeness of three such fuzzy words should not, however, dissuade us from trying to find out what might be gained by investigating them.

Information systems design for urban and regional planners has developed out of several traditions, each with their own disciplines, professional associations, methods of qualification, and styles of verification. Architecture, civil engineering, and public works begot town planning; law, colonial administration, and management schools begot public administration or management,5/ bookkeeping, auditing, and cost accountancy begot the treasury, while information systems design has grown out of computer science, librarianship, management, and several other fields as well.

In turn, there are quite distinct traditions within the field of urban and regional planning dealing with the design of information systems. A cartographer details maps, a statistician figures, a modeler models, a librarian organizes published documents, a bookkeeper keeps books, the police implement laws. The degree of detail, the proof of rigour, the reporting structure the authority routes for, all these differ. The development of computing and communication devices has impinged on all these people in different ways. To some extent, perhaps the computer professional has been given too much influence.

There is a tendency for the computer scientist to date the emergence of information systems from the emergence of his first big box -- say about thirty years. There is a more healthy tradition in Western public administration to find a history of information capture, storage, retrieval, processing, and dissemination dating back to at least Asurbanipal and his tablets of clay, then through the Assyrian Empire, Ancient Egypt, Greece, and Rome, through the Roman Catholic Church, the feudal empires, and the emergence of bourgeois capital, to the modern state, with similar histories in the East and the Americas.

Though to my best knowledge no one has yet charted a history of these developments from the perspective of modern ideas of the design of information systems, and no one has attempted yet to analyse what will be the central thrust of this paper retrospectively, it is useful to begin by recognizing that what follows is not simply the result of the computer. The paper draws on much older ideas at times and is intended to intervene in systems of public administration, the origins of which are lost in the mists of time. Without a historic perspective of how and why those systems developed as they did, it will be impossible to comprehend how they might be changed. And to bring to bear a Euro-Centric or Pan-Am sense of history and development will render the task equally futile.

In the more immediate past, it is not only the emergence of the computer which has opened the subject to such enthusiastic discussion; it is the emergence in a world recession. At other times new technologies have developed without a major intellectual paradigm shift. That is not happening this time. It is because the period of substantial growth in the world system from the end of the Second World War came to an end during the late 1960s, a period of growth which formed the ideas of a generation, that this generation is having to relearn from first principles the bases of social organization. Now that the recession has lasted at least half as long as the period of growth, it is not possible to write it off as a hiccup. The old ideas of "development" in the third world are dead.6/ The old ideas of computerization, data processing, and so forth ought to be as dead as their punch cards, but are taking longer to die.

The final central difficulty for us is that most writing on information systems design deals with the private sector, where a stab at getting things right is motivated by the prospect of going bankrupt. In the field of public policy and planning, our ability to evaluate our limitations is clouded by the powerlessness of the suppliers of our information and buyers of the services. The State, as the highest public authority, has no God to arbitrate a higher truth system.

In this resource paper, I have attempted to briefly distill a standard method for designing an information system, then indicate the difficulties; thereafter a quick run through the sources of information on which planners might draw. I have then commented on some of the particular conditions which apply in developing countries. In the section on institutions I have outlined some of the organizational complexities. Next I have indicated some of the technical developments which might aid us and finally I have made a stab at outlining a method of work which might help us.

Throughout I have tried to indicate that training is the central issue -- not training in the abstract but action training, bringing to bear a critical evaluation of practice with practical activity.

INFORMATION SYSTEMS DESIGN

The growth of the information consultancy industry in the past ten years has been sufficiently phenomenal for us to take their arguments as a starting point for examining strategies of information systems design. Their experiences appear in the literature of a number of international bodies such as the International Federation for Information Processing (IFIP), in journals such as *Harvard Business Review, MIS Quarterly,* and *Long Range Planning* (with another 600 indexed by ABI/Inform for example), and in texts published by companies such as Arthur D. Little, Arthur Anderson, AT Kearney, and Cooper & Lybrand. The literature is too extensive to document here.

There are, though, two clear fields from which the work has come -- the major computer manufacturers who wish to sell their boxes, and the major management consultancies, who wish to sell their services. The consensus might be simplified as follows:

1. Identify the broad strategic requirements of the organization. It is unlikely that the people engaged in designing

and implementing the information system strategy will be capable also of setting this broader strategy -- it is much more likely that they will be responding to it. But it is absolutely essential that they do not try to operate independently of it.

2. Identify the critical factors which are likely to need to be achieved in order that this strategy might be effective.

3. Identify the decisions which have to be taken so that the orientation of resources into the areas of activity which will lead to these critical issues being prioritized might be achieved.

4. Identify the people who will be making these decisions. Ascertain that it is clear that they are the people, that they think they are the people, and that those to whom they report, and who report to them, understand this to be the case.

5. Identify the information they require in order to take these decisions, to monitor the implementation, and evaluate the impact. Some of this information they might have in a usable form.

6. Identify the operations from which this information is derived.

7. Identify the other stated purposes of those operations.

8. Cost the operations of the organization against the benefits accrued from them.

9. Design the strategy which will gain the maximum movement in the direction of the strategy with the minimum investment.

On the implementation of the strategy there also appears a consensus.

1. An officer at the highest level of the organization has to be appointed to lead the exercise.

2. It has to have the backing of the entire organization at that level.

3. It has to have built in a review procedure with all the milestones that any project would have.

4. At each level agreement has to be gained that the "information, the whole information, and nothing but the informa-

tion" has been modeled. This level of responsibility is likely to be resisted by line staff if either the atmosphere will not allow them to indicate inconsistencies at higher levels of the organization or if they feel that they are likely to prejudice their own competitive advantage within the organization.

5. The tactical consequences of the strategy need to be modeled and developed in a structured system which will lead to building a coherence within the organization both in time -- implementations, data dictionaries, logical data structures, data flow diagrams, entity life histories, and documentation have to be replicable; and in space -- coherence of the organizational structure has to be achieved. It is not the intention of this paper to examine or comment on structured system design methods, though I have drawn references to useful texts.7/

6. On this basis a functional specification may be drawn up which can be costed in terms of: (a) capital expenditure on software, hardware, and data capture, (b) system running costs, and (c) measurable incomes.

7. At this point budgets and tender documents may be constructed for the parts of the exercise requiring procurement, including amortization periods, procurement expenses, training related issues, and consumables. Penalties for nonperformance and delays, plus mechanism for damage limitation resulting from overrun on cost and/or time (usually and) need to be stipulated. This paper does not deal with these issues either.

8. From here on the exercise might be seen as a standard exercise in project management where there is no distinguishing characteristic of any information system from any other planned human activity.

Now there seem to be a number of problems with this sort of approach.

1. It is presumed from the beginning that we know what the organization is, and that the organization is internally coherent. Yet it is often precisely at the boundaries between parts of an organization, or between that one and another where you find the problems. Primary loyalty of staff might be to their own immediate head, or to the department, or to the institution. In diversified organizations or in places where there is more than one reporting path, depth of information management is a consequence of lack of management clarity.

In designing the strategy are you looking at the part of an organization where influence and spending control is such that you can move swiftly, with the consequence of the development of islands of automation, or is the decision making process so complex that you will never be able to get started? The Madras Metropolitan Development Authority has been committeeing the issue since 1979, and still has not a single box in place.

2. Who decides on what the critical factors actually are? Where there are clear lines of reporting and decision making, achieving agreement might appear simple and straightforward. It might also be true that if there is that level of sophistication in the organization, then, in turn, there will be little difficulty in developing an information strategy. However, the point of agreeing on the critical success factors is to be able to deal with the future not with the past. The point of having a strategy is to deal with the unknown, not with that already experienced. A single clear path of authority, which might at times be called dictatorial, bears no guarantee of being reliable. The task is to marry organizational form with culture to engage the future.

3. Most of the writing dealing with these topics comes from the private sector. It is generally recognized that under those circumstances the central issues are maximizing the rate of return on capital, increasing market share, reducing inventory costs against delivery benefits, and similar strategic requirements. In the public sector the issue is much more complex.

At the highest level the conflict between a subsystem and the macrosystem might be modeled by noting that an oft-stated strategic requirement of an organization is cost displacement, an anodyne phrase which means putting people out of work. There are two factors. Firstly, putting people out of work, or investing in new technology cannot be a critical factor in an organization in itself; it depends on the general value of labour throughout the society as a whole. Secondly, putting people out of work within one organization removes those people's ability to consume the products of other sections of the economy until they manage to devise a mechanism for selling their labour power. In any one company within the private sector, the shareholders cannot be expected to sacrifice their profits for a public good -- unless as a clearly charitable gesture to be supported by increased profits elsewhere in the organization -- on the contrary they will remove their investment to an industry with a higher rate of profit. But the shareholders of the country at large, or seeing there can be no national boundaries to an economy, the shareholders of the world at large, are going to have to bear the burden of all this surplus labour, and be unable to sell their commodities and therefore unable to realize the return on their investment. So within the public sector there are a number of quite specific problems.

4. The drawing up of a strategy document, the purchase of a piece of equipment, or the design of a data base is an event. But within a system the handling of information is a process. It is therefore necessary to design a strategy so that it, in turn, becomes a process. But precisely because it is trying to deal with a future, a snapshot will be out of date as soon as it has been taken.

5. It hides the detail of conflict within an organization. Individuals and subcultures have their own trajectories within every institution. Any intervention will be either opposed by individuals or groups according to how it intersects with their presumptions.

6. The issue of "proof" remains untouched. If a strategy is going to attain a goal which is set some time in the future, and that something other than profit or loss is to be the criterion of measurement (and even if those are the only criteria there remains the problem of contingent factors -- what was the contribution of the investment to that achievement), then there has to be some agreement on units of measurement in order that there can be agreement on progress. It might be worth stating fairly categorically that expenditure of public money is not expenditure of something which comes from nothing, it is the result of people's labour, and often involves expenditure over which they have had no control. At the most basic level we might hold ourselves responsible for consuming the results of others' work.

7. Information is itself a rather limited commodity. It neither has power nor takes decisions. It cannot be eaten and the market in which it can be sold is still a limited one. The case that buying and selling it leads to an improvement in the common good still rests on slender evidence. Attempts to design information systems, because of a certain insistence upon rationality, bring to the surface conflicts within and between organizations, which cannot be resolved simply in terms of information itself. Yet to then place those decisions outside the domain of designing information strategies is to condemn the system never to work.

DESIGNING AND IMPLEMENTING IS STRATEGIES

THE PLANNERS' USE OF INFORMATION

Let us look in a rather cursory way at the information which could be used by urban and regional planners.

1. Any description will start with the numbers of people involved. This usually is the result of a census, from the times of the Roman empire onwards, and there is a rich literature dealing with the inadequacies of censuses.8/ But most important of all probably is that censuses deal with where people live, not with where they work. Detailed data systematically collected on the economic activities which form the basis of human systems is rare.

   There is no country in the world in which by now work has not been done on the computerization of the census.9/ Yet the problems of getting the right information at the right time and being able to use it remain enormous for the planner.

2. This human activity is spatially located. Maps are drawn with varying regularity showing the detail of physical features of landscapes. In urban centres they might be drawn to the level of permanent roads and blocks of land. Paper based maps have the limitation that if more than a few data sets are included the page becomes: (a) so cluttered that it is impossible to read, (b) extremely expensive to produce, (c) out of date before it is printed. Techniques of digitizing maps are now commonplace,10/ and the technology cheap, so the problems are organizational.

3. Utilities are the lifeblood of any community. Water, sewage, energy, communications are all the responsibility of different organizations, some in the public sector, some in the private sector. They all require physical components -- roads, wires, pipes, junctions, interchanges, which have all to be physically located somewhere in space; they all have physical limitations -- capacity, decay, repair, cost. Investment in them has an economic consequence and costs money which has to come from somewhere. Yet it is unlikely that any one organization will either know where the infrastructure of another utility actually is or cooperate in development or maintenance. There is a lack of coordination of information, which the option of a minimum data set on a digitized map could alleviate.

4. There must exist a certain infrastructure of social reproduction without which the community will die. Housing, health, and education are all complex social phenomena dis-

cussed at length in many other places. This paper does not attempt to deal with the nature of these institutions, simply with the informational consequences of their existence and the planners' requirements for information. The requirements are fourfold -- what exists at present, where they are located, what are the costs of production and consumption, and what are the linkages between these institutions and other aspects of policy? The information issues are probably not substantially different from those of the utilities. The agencies involved might be more complex, there might be a more substantial body of theory, the division between the technical and the social might be more wide (the latter a consequence of the former), but there appear no significant issues of information principle.

5. Within this environment people engage in economic activity, producing and reproducing the daily conditions of their material existence. They do this working as individuals, in small groups and in large organizations, with all sorts of different property relations and conditions of labour. Yet information on these activities disaggregated to the urban or suburban level is extremely hard to come by. This paper once again is concerned with the organization of information, not with the substantive issues of urban life, but a couple of exemplary sources might usefully be referred to.11/ These all comment on the information problems.

6. In this community people are born, die, pay taxes. There are sets of administrative procedures which record their activities and extract from them various parts of the rewards of their labour for various purposes. The units engaged in these activities in general form what might be called public administration.

7. The units, or others like them, in turn, spend the results of the tax gathering exercise, either paying back loans from previous spending exercises, paying their own costs, or engaging in new ones. They might do this according to some sort of budget or plan, they might keep some sort of accounts, and they might manage projects. General issues of public administration have been discussed widely. There is a rich literature and specialist courses on project planning and administration, but how this fits in with information systems design has had less attention.

8. In addition to the relationship with public administration, all these people engage in activities with one another and with social institutions, in which they dispose of their incomes either by spending or by saving. All these institutions, in turn, contribute in some way to the taxation

system, as do their individual practitioners. In all these activities they produce information, and all these activities, no matter how tiny or trivial have some relationship with one another.

9. Possibly, rather unfortunately in the minds of some, there will be some people in this fantastical community who might have different ideas about the meaning of life and their purpose on the earth from others. Conflict might be stated to be a normal condition; it certainly has a substantial literature, but the only concern here is that a police force, a prison service, a judiciary -- a body of armed men -- develops, receives funds, spends them, collects information, organizes it, uses it, and engages in activity both as a result of policies based on information and as a result of having engaged in information activity.

10. All these activities change over time so that even a survey is out of date before it is completed, presuming that it had any relationship with reality while being conducted. Problems of survey method, technique, and analysis have been widely discussed elsewhere.12/ The issues are too substantial to be discussed here. But the change over time means that the information system must be a processional one. It is this relationship which returns us to the idea of an information "system" which has to be linked to the development of automation of decision taking processes.

11. These activities take place in a particular set of social relationships involving the ownership of property, capital, stocks and bonds, but most important, land. The registration and contest of the ownership of land means that a land registration process is one of the most important information issues over long periods of time. In Britain, for example, there has not been a general registration of land for nearly one thousand years.

While not a complete account of the information on which planners might draw, there is probably enough here to keep us occupied for the rest of this paper. It is interesting that in Britain a House of Lords Committee has sat on Geographic Information Systems, so greater forces than ours are considering these issues.13/

It is not difficult to see from this slight list that a number of problems emerge. These are not limited to the information component, they have been commented on elsewhere, but the attempt to set up an information system means that we cannot ignore them.

1. There is potentially a huge mass of data. The problem is not that we do not have enough information, it is that we have a huge, undifferentiated morass of the stuff.

2. For the information to be useful it has to be aggregated or disaggregated to the level of detail required for the decision making process within which we are involved. It has to be in the right place, at the right time; in other words it is spatially and temporally specific, and these specificities might be different from those at its generation.

3. All information costs money to collect, store, retrieve, process, and distribute. The costs of parts of the collection are completely separate from possible users.

4. Levels of social organization -- person, family, household, community, suburban, urban, regional, national, state, international, have no logical or epistemological relationship. Relationships are perceived differently by different players in the game and have different power balances.

5. The social and administrative organizations which develop relate to one another in ways which are often unplanned, where the actors have their own interests in mind as well as those of people they are serving. Established communities will be quite different from greenfield sites which will be quite different from new communities developing in response to changes in the world market. It is this sense of the unplanned dynamo of the world market and the attempts of small social units to operate in a planned way in that market which we have to grasp.

6. Planners, in the sense which a profession will understand itself, exist separately from the agencies of power in society, either that agency which owns and controls property, and on the basis of which controls the body of armed men who keep it in place; or the agency which produces the wealth of the world on the basis of selling its power to labour. It is for this reason that the act of planning has been separated from the implementation of those plans.14/

7. The response of social democratic societies to the recession in the world economy has been to draw in the social democratic form of their organization and to emphasize the competitive, profit-making component, on the basis of which competing capitals survive or go bust. Under these circumstances the idea of planning, or the idea of a system as rational beyond the immediate requirement of one competing actor, has been unfashionable. The role of the state as both the agent for organizing the competitive advantage of

one world capital against another and for organizing the competing capitals within that state has reappeared in issues of privatization, monetary policy, cuts in public expenditure which have left no part of the world untouched.15/

8. The planning profession has had to engage in a very fast change of paradigm, from an architecturally-based tradition involved in the spatial organization of physical objects to concern with developing the competitive advantage of small spatial units. Meanwhile the idea of a "country" as a unit of competition in a world market has been subverted by the internationalization of capital on the one hand and the attempt of subnational units to gain a comparative advantage. Development agencies within a country will compete to give resources to companies in order to attract them. Such is the scramble in Europe that an expert system has been set up to help companies decide where to relocate.16/

9. It is possible that the rules by which exercises in transforming management structures to give a company strategic edge might apply to these small subnational planning agencies, but it is not clear how. The attempts to measure costs and benefits in a market of competing capitals are difficult enough. Attempts to define those rules in the public sector have tangled with the clearly political issues outlined above. As I summarized when speaking at a conference for librarians, they have a choice: public libraries -- open, free, dirty, understocked, and out of date, or charging for value added services, profitable and privatized.

To the extent that planning agencies are unprofitable or appear to impede the short-term generation of profits they will be attacked. To the extent that they attempt to create or facilitate the creation of wealth they will be underfunded, seen as unfairly competing, or become another competitor seeking its own advantage.

10. There is no logical division from the individual to the whole world. Historic divisions into nations and within that the division of administrative units based on local government are increasingly not useful. The complexity of administrative units in established societies makes for incoherent production of information and organizational complexity of superhuman dimensions with any attempt to coordinate.

11. There is a historic separation between the agencies responsible for administration of policies and those making policies. Operational information is not generated in a form

which lead to its being of any use for decision making processes.

12. There is a large and established body of people whose livelihood is based on implementing low level bureaucratic functions who are opposed to automation unless they can see it as being life-enhancing for themselves.

THE CONTEXT OF DEVELOPING COUNTRIES

In addition to all the above, there are a number of issues which arise specifically from the condition of developing countries. At one level these all link together and overlap. These in part concern the technologies which are necessary to manipulate information and in part the management of the information itself. This paper cannot address them in detail, but it might be useful to at least produce a list.

1. There is a fashionable argument that information technology is inappropriate for developing countries, which is often heard from Western Europe advisers who are of the opinion that the third world consists of a rural population continually on the brink of starvation, for whom only the most primitive tools will be suitable.17/

2. All information technology bought in from outside suppliers will have to be paid for in hard currency, a very rare commodity in most developing countries.

3. There are a number of legal limitations which are imposed by developing countries either in an attempt to defend their national boundaries or to exercise some control over their economies. The effect of these is probably counterproductive because governments are powerless to effect any real change in the world economy, but they succeed in impeding import of useful components.

4. Aid funding agencies have interests at heart other than the improvement of the universal good. National policy usually requires that wherever possible only nationals of the aid-granting country will be funded, and only equipment produced within that country will be supplied. At the level of software this leads to considerable waste.18/

5. Training has attracted considerable attention. Two issues emerge: What is the most appropriate form of training in terms of level, location, and content19/ and how do we evaluate training? This latter topic seems to me to be the

one to which we should address most attention. There is a considerable amount of money being spent on aid training related activities, with no evaluation of courses, materials, or applicability.20/

6. Within particular types of administration prevalent in "developing" countries there are tendencies to centralization of decision making which lead to tendencies in the design of information systems requiring large-scale computing resources. The costs of mainframe installations can be much higher per unit of computing capacity than microcomputer-based installations, yet decentralized solutions have not been investigated for any major project.

7. Centralization of decision making, in turn, leads to shifts in the balance of power within society. Though there is a tendency to talk of developing countries as homogeneous wholes, it must be borne in mind that many of them have not the slightest characteristic of democracy in the distribution of power or decision making. Indeed the failure of many projects has resulted from the cavalier method by which those whom the project is intended to benefit are excluded from a part in the decision making process.

8. Developments in modern information management require an efficient telecommunications infrastructure. Combinations of land-line and satellite communication, options of digital exchanges and optical fibers are all changing the economics of telecommunications provision, but there is little work being done on projects for upgrading.21/

9. The linking together of all the non-OECD countries as "developing" leads to a confusion. There are parts of Brazil, Mexico, and India, for example, which are as "developed" as any part of Europe; there are equally parts of those countries which are as primitive as anywhere in the world. Thinking about those countries as units of development leads to all sorts of confusions.22/

10. A major source of difficulty is the way in which project funding is undertaken by both multilateral and bilateral programmes. There is now a significant literature dealing with this issue. There are just a few points which might be worth listing:

    - Funding is for "projects" which tend to be short-term, finite, and not allow for continuing development. With the installation of computer centres this is disastrous;

    - Projects have to be initiated by the "developing" country;

- The aid-giving country appoints its own "nationals," supplies its "own" equipment, and provides training in its institutions.23/

11. Levels at which data is collected, e.g., census, register of births and deaths, property registers, and levels of detail, e.g., mapping, provide data which cannot adequately be aggregated to a level usable at the implementation of policy. On the other hand, nationally aggregated data, as will emerge for example from the Indian "NICNET" proposal, does not exist at the intermediate level.

12. Coordination/cooperation is difficult to organize among institutions competing for scarce resources. Ministries and departments engaging on programming of office automation or the development of information systems come quickly up against the desire to draw on the information of others, but are reluctant to become information providers.

    Attempts to formulate policy either for information technology or information systems have not been successful. National informatics centres or national computer centres have had a limited life span and a limited value; with the increasing availability of microcomputer-based systems and development in telecommunications the issue of the design of information systems has become more and more important. Training in this field is possibly now the most urgent practical activity which has to be considered.

    The range of information systems which are being implemented which I gave earlier indicates the scope; the problems I have indicated show the difficulty. Which agency should be responsible for coordination will involve the varying power or different institutions and in federal societies affect the balance of forces.

13. For large data processing centres servicing and maintenance has always had to be a major factor. The growth of indigenous microcomputer industries in a number of developing countries has reduced the dependence on large-scale overseas purchases. Where such an industry does not exist, the development of information systems design strategies cannot be separated from a consideration of the creation of such an industry.24/

If these general problems face any attempt to engage in change in developing countries, it might be then worth also mentioning that particular difficulties exist within the range of information activities mentioned earlier.

1. Statistics are always out of date. If the censuses are conducted, then a huge amount of data becomes available at one moment, which has to be processed. Many developing countries (and some developed, e.g., West Germany has not conducted a census for many years as a result of popular opposition) have not made the resources available for years to take a census. They are unreliable, both for purely practical reasons -- people move around during the day, and for tactical reasons, administrations and groups want that there be less or more people than there actually are. Under some circumstances people are required to return to their place of birth for the census, a singularly useless activity.25/

2. Maps in many third world countries date from the Second World War. Attempts to produce maps to the standard of American or British military requirements are prohibitively expensive, yet these are the standards to which many consultancy companies work so the idea of cheap and nasty results does not appeal to them. Where mapping has been undertaken within the country for military purposes, the documents might not be available for civilian purposes. Printed maps wear out, become dirty and unreadable, are at specific scales, and record specific information. Modern production of maps relies either on Landsat type data or the digitizing of existing maps. Landsat data is expensive, digitizing time consuming.26/

3. Administrative units are conservative units in a period of rapid change. They exist for their own purposes, whatever the reason they were set up. Their boundaries overlap and change. There is a very fast rate of change in the units with which they are concerned -- people, economic activities, housing, and so forth. People are born, die, and move at a greater rate than in developed countries, with a consequent increase in the rate of change of information.

4. The ownership of land and its distribution is possibly the central political issue, along with taxation, with which it is associated. Information on these two topics is potentially dangerous. There is also a long tradition of regarding it as private.

5. Channels of communication are undeveloped. Postal and telecommunication services will be limited, roads frequently impassable, with the result that the movement of information will be slow and unreliable.

INSTITUTIONS

Let us now summarize the institutions which might be concerned in this panoply of information. Much of this has been discussed by, among others, Salmona,27/ so this is only a summary.

1. At the lowest level there are sets of administrative units.

An enumeration district will be the smallest unit for the purpose of taking a census -- usually regarded as the area to be covered by one enumerator on the day of the census. These areas have to be worked out before the census can be taken, which means they have to be based on some information or other, routes or area plans have to be given to the enumerators. Yet the exercise of planning and taking the census will be organized nationally, distinct from local administration.

A voting district will be the smallest area for which a representative local government will be returned, where this form of local government exists.28/ In any country where elections are held, there needs to be some form of registration of voters, recording votes, and a mechanism for distribution, collecting and counting votes, albeit there is frequently a significant level of corruption. There might be some sort of relationship between voting areas for local government, let us use the English word, a ward, and for national elections, let us call it a constituency. But offices responsible for this might not be part of the local government.

There might be a division of the country for taxation purposes into collector's areas or districts. Differences exist among countries which experienced the British Colonial Administration from those which enjoyed other colonial powers, or those which have always remained independent. Some form of district (urban and rural), division, province, region or state, with something like three tiers of government seems common. The division of responsibility or allocation of functions among these bodies will vary widely as will their powers and ability to engage in fiduciary and juridical activity. Taxation and collection will be separate from local administration as will the legal process.29/

Within these boundaries or enjoying others of their own, will be all the other aspects of public administration, which in addition to the horizontal complexity of their relationships will, in turn, have relationships to higher levels of governments and responsibility to ministries, with some sort of complexity of power sharing and competition for resources at each level. The complexity of these patterns cannot be described in any way which might produce useful generalizations. It might be remarked, however, that this is no different from the complexity of the range of private sector agencies in the developed world, and that has not prevented us from generating some ideas on the design of information systems.

At the local level there might be some sort of agency of higher education, such as a university, which might engage in research and publication. It seems common for there to be no effective link between universities and local planning agencies, and for one another not to draw on the other's work. It seems uncommon for there to be established libraries or documentation centres for local information. It seems even more unusual for this published information to be available nationally.30/

2. The complexity of intermediate units of administration preclude commenting on their differentiation. We move therefore directly to the "highest" level within the nation state.

There is likely to be some sort of national statistical body. It might be responsible for the decennial census, it might be responsible for only demographic activity, it might share its resources among ministries, or each ministry might have its own statistical section, but in some form or other data will be collected, processed, and stored. There might or might not be a national collection of statistical papers or data sets. Information on statistical data sets is nowhere as well documented as bibliographic material. It is worth drawing attention though to the work of the United Nations Industrial Development Organization (UNIDO)31/ in attempting to coordinate improvement in national time series. In some countries the planning for the census takes place over a number of years, and involves a wide range of possible users.

If the statistical data is complex, as soon as one attempts some understanding of the fiscal statistics from which to understand the functioning of the economy, life becomes even more difficult. National data might be held by the Central Bank. It is worth drawing attention to the work of Chadwyck Healey here and of the International Monetary Fund (IMF).32/ All this data, though, is likely to be aggregated to the national level, which will precisely destroy that level of disaggregation which is essential.

There might be some sort of registration of births and deaths. Why this sort of data is registered centrally, rather than with the local unit of administration might simply be the result of following the British pattern of the 19th century. There will also be enormous variations in the accuracy of registrations, the form of data handling, and the system's capacity for report generation or query handling.

From the local administrative units mentioned earlier, there will be some aggregated national data on taxation, health, education, land registration, and so forth, probably located within the respective ministries and unavailable to others, except in the form of some sort of annual publication. These sources of information might be organized in some sort of national archive.33/ There might also be a government printer or stationery office responsible for the publication of government reports.

What follows from the wealth of possible information in published form is information on the organization of it all. This is central to the world of librarianship. Often material on a particular country will be more available in Washington, London, Paris, or Geneva than in the developing country. Information on developing countries suffers a number of disadvantages in comparison to that of, say, chemical engineering or abstract physics.34/

Mapping at the national level is the responsibility of a national survey. Aid is available from a number of agencies which have made this their particular responsibility.35/ Mapping has historically been physical or political. It is unlikely that there will be a link between mapping and property relationships, or other agencies of government.

Depending on levels of development, STD numbers and postcodes will have emerged over the past ten years or so, and their use in information planning will have been noticed.36/ There might also be a range of directories, telephone, trade, street, and so forth, which might be published either nationally or locally, either in the public sector or the private sector and either on paper or in an electronic medium.

There is nothing novel or interesting simply in listing the above. It is the range of computer software, the availability of cheap microprocessors and developments in telecommunications which have become widely available in the past five years that makes the difference. There are many directories, surveys, and evaluations on software. They emerge at such a rate that it is impossible to keep up-to-date. Information from manufacturers of equipment spills out endlessly.37/

TECHNOLOGY

It is presumed that readers of this paper have a basic knowledge of contemporary computing developments. This section summarizes recent developments in a number of software packages.

1. Some packages have become so widely available that there is probably no need to do other than list them: word processing is now commonplace and widely understood, dBASE II and III are probably the most widely available data base management packages for single user microcomputers, just as the IBM-PC range (and its clones) is the most widely available machine. LOTUS 1-2-3 is probably the best known spreadsheet, with a number of applications developed for it with particular planning uses. The Bertaud model,38/ PORTKIT (though developed in SUPERCALC works on the same principle and would be easy to transfer),39/ and many other applications have been developed in this way. The Habitat microcomputer users' newsletter helps to keep people who are working in this field up-to-date. Whether a spreadsheet might just be considered as a particular presentation of a data base interface is arguable, but the argument about the general structure of these packages and the man-machine interfaces seems to have settled down.

   It is in some ways unfortunate that the IBM MS-DOS standard developed in the way it did; the Macintosh has so much more to offer the unskilled user who wants to start from the beginning. The speed with which prototypes can be developed using JAZZ on the Macintosh in comparison to dBASE III on the IBM is striking. The development of packages such as GEM and WINDOWS, which gives an object-oriented approach to the IBM clone is in progress, but the complexity of setting up, and the range of possible incompatibilities are still considerable. However, the use of one of these packages to develop a social accounting matrix, compared with the methods Pyatt and Roe describe in the mid-1970s, gives a good example of the speed with which the rate of development has changed.40/

2. The more sophisticated statistical packages which were developed for mainframe applications such as SPSS and SASPAC are now available on PC versions, though usually requiring at least 512KB. They are usually well documented and though

not cheap, very cheap in comparison to the costs of the days of mainframes. Data base management beyond simply statistical applications becomes more technical than this paper would wish to be. Packages such as INGRES and 4GL development tools should be mentioned, as should packages aimed at specific tasks such as handling text rather than numbers, such as Micro CDS ISIS developed by the United Nations Educational, Scientific and Cultural Organization (UNESCO) and available free.

3. What becomes interesting from the point of view of the planner, though, is that the manipulation of statistical data with a spatial dimension is possible. Early attempts were developed with primitive digitizing and graphics packages using some language such as BASIC, such as the UNCHS UDMS or Housing Finance package, or examples such as those cited by Ottensmann.41/ One of the larger machine combinations of MINITAB and GINO or GIMMS was used to produce useful documents such as the Kingston Atlas.42/ Over the past five years much more sophisticated tools have emerged such as MAPPICS,43/ and considerable work has been done on using data from remote-sensed sources. Recent advances as recorded by the Spatially-Oriented Remote Sensing Association (SORSA),44/ have been the focus of the work of the International Institute for Aerospace Survey and Earth Sciences (ITC), Enschede. The Urban Data Management Symposia (UDMS) series in Europe provides frequent case studies.45/ Work at Visakhapatnam too might be referred to.46/

4. Much of the difficulty of communicating data among machines has been removed by the free availability of Kermit, provided machines are in close proximity. Data communication among distant sites is almost everywhere dependent on PSTN, or, in a few cases, IPSS. ISDN is still a wishful thought in most parts of the world. This severely limits the realistic quantity and quality of distance communication, leaving paper, floppy disks through the post, and other low-technology solutions viable alternatives.

Though international standardization is unlikely as long as there is competition in the market, the issue is not as fraught as a few years ago. Advanced workstations running graphics applications rather than simple ASCII files introduce a new level of complication, however. Their general use in developing countries is not yet apparent. CD-ROM provides an alternative for very large data communication. There is now at least one UNESCO project examining the value of this medium in developing countries.

The general issue of networks and their capacity for improving development options I have dealt with in detail elsewhere.47/

5. Project planning and management and financial control packages are in part a development of 4GLs, but include a significant set of algorithms that they might be said to contain an element of expert knowledge. Packages such as ARTEMIS now run on microcomputers, at the higher price range, and spreadsheets from a few dollars, if not in practice free. Data modeling facilities, critical path analysis, and PERT options are common.

6. It is also worth drawing attention to software development and information system design aiding tools which are now reaching the level of sophistication that they might be used by nonspecialists.48/

   These are usually dependent on some standard development method such as I have outlined earlier and are unlikely to deal with strategic issues. The methods are probably usefully summarized by Martin.49/

   A less expensive, if not so detailed description might be found in Sprague and McNurlin,50/ for example. There are many others along similar lines, with no real points of difference.

7. The use of expert systems and applications of artificial intelligence are not yet apparent in planning agencies in Europe, never mind in developing countries, though here is a field of development of which we need to be aware. Experimental work is still not at the level whereby we can give any case studies from which we might be able to draw critical conclusions, but enough resources are being put into the field that we will need to be able to comment soon. The hazards seem enormous.

STRATEGY

Having summarized the various areas in which information is generated and manipulated on which planners might be able to draw, I must now return to the general issues in information systems design strategy.

I am not attempting in this paper to deal with the operational details of how to implement information systems, simply dealing with the issue of strategy, but it might be useful first to list the factors which have to be borne in mind when designing and implementing the functionality of an information system. These are in no order, just a checklist:

a. Keeping goal. How long does the data need to be kept for?

b. Bulk. What quantity of data are you considering?

c. Speed of writing. What is the rate of creation of new data?

d. Speed of recall. What is the essential rate of recall of one record sequentially? and of one record specifically?

e. Frequency of recall. What quantity of data is required over what time period?

f. Rate of change of data. What quantity changes over what time period?

g. What are the costs involved? Capital equipment, including servicing, consumables; storage costs, including maintaining the data; transportation costs, getting the data from the point of creation to the point of consumption; creation/retrieval costs, including time of the users of the information.

h. Proof of transaction. What proof is required at what legal level?

i. Transmission. Over what geographical spread at what rate is the data required?

j. Transportability. What equipment is needed in what environment?

k. Compatibility. Into what different systems does the data have to be ported?

l. Security. How much is the data worth, and to whom?

m. How many users, simultaneously and over a time span, with what skill levels?

It might also be worth summarizing some of the experiences of why information systems have failed, or are seen to be deficient. An agreed list might include:

efficiency -- the system fails to operate according to specification;

timeliness -- the system is incapable of delivering information at the speed required to be useful (the census results I have mentioned earlier might be seen as an example of this);

accuracy -- data cannot be delivered at a suitable level, though usually this is due to results of aggregation or inability to disaggregate when dealing with planning issues;

security -- a major issue when financial transactions are involved, but important even when dealing with, for example, land issues on which money might be made or lost;

compatibility -- still a problem, requiring a high level of technical competence to alleviate;

implementability -- result of salesmen selling boxes inappropriate for the environment in which they are to be operated;

maintainability -- a particular problem in developing countries, where the repair or replacement source is thousands of miles away;

robustness -- not just at the level of needing air-conditioning to keep the plant running, but in the programming tools, the ability to adjust to changes in the users' environment;

portability -- not just in the joking sense of the mainframe rather than the lap-top, but in the data design structures required by many older machines;

acceptability -- to the whole of the environment in which the system is to be installed, all the people who will come into contact with it; lack of acceptability is the result of the failure of the "computer" fiend to take into account the social and human factors which other people bring to bear;

cost-effectiveness -- capital and consumable costs are written into a one-off project specification, but the system has to run for many years beyond the project funding.

The problems for designing and implementing information strategies for urban and regional planners might now be summarized:

1. A culture gap exists at several levels. Historically urban planning was concerned with the physical form of social organization. In many cases, moving out of that discipline has proved difficult. Secondly, the role of information technology has proven difficult to take on board. Thirdly, there is a culture among local government administrators that they are paid to do what they are told. It is not their job to think and take initiative. Indeed this might be positively discouraged and in some cases dangerous.

2. There is a perceived lack of power in the political process. Urban planners exist within powerless sections of the local government hierarchy, and as soon as they are asked to move away from the physical planning of which they have experience, they notice that decisions affecting the issues over which they are expected to plan are taken elsewhere, usually within central government.

3. Aid funded projects are infrequently found in the domain of urban planning, though the fashions fluctuate.

4. They will suffer a series of legal restraints which limit their field of activity.

5. Their "suppliers" of information and the "buyers" of their services are either powerless (often called the poor) or more powerful than they (the patrons).

6. There is a historic separation of planning from implementation. This was fostered by the tendency to bring in international consultants who generated beautifully printed documents unrelated to any practical implementation. There is also a lack of history of the economic evaluation of projects.

7. The unit linkages among agencies concerned in the implementation of the planning process are often weak and unregulated, enhanced by weakness in the communication infrastructure.

These topics have been dealt with over a number of years.51/

To them might be added the more general problems of information systems strategy:

1. Most work has been done within the private sector. To establish cost justification or benefit models within the public sector is difficult.

2. There are no established methods for deciding which technique for solving an information problem is most appropriate.

3. There is no authority above the participants to decide whether a particular approach is right or not -- there is no proof of the correctness of the identification of the problem. The time series on which solutions are implemented is too long for a causal relationship to be established between changes in the perception of the participants and implementation.

4. Information problems are often only manifestations of more substantial organizational or environmental problems over which the information strategy designer has no influence or power.

Undaunted, let us attempt to outline how a strategy might be developed and implemented.

1. The general statement of principles is simple:

   (a) Determine the strategic objectives of the organization. If they do not exist formally, attempt to engage people in their articulation.

   (b) Establish the critical success factors which are agreed upon among the participants.

   (c) Establish the people and processes by which decisions are taken, monitored, and evaluated.

   (d) Establish the information on which these decisions are taken.

   (e) Locate and chart the operations which generate this information.

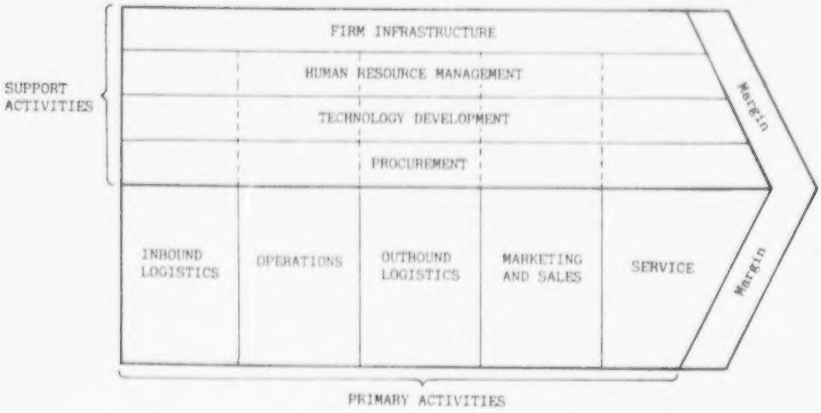
   (f) Determine the sources of data on which these operations are dependent.

   (g) Model the process by which changes in the data over time affect changes in decisions.

2. Construct the value chain and cost drivers of the agencies concerned over time (figure 1). See Porter52/ for a detailed discussion of this technique. He does not deal with a public sector agency, but it does not take a lot of imagination to see how the tool might be applied. There are, though, all the well-established problems from operations

management to be taken into account.

Figure 71. Organizational Value Chain and Cost Drivers


SUPPORT ACTIVITIES
FIRM INFRASTRUCTURE
HUMAN RESOURCE MANAGEMENT
TECHNOLOGY DEVELOPMENT
PROCUREMENT
Margin
INBOUND LOGISTICS
OPERATIONS
OUTBOUND LOGISTICS
MARKETING AND SALES
SERVICE
Margin
PRIMARY ACTIVITIES

Source: Michael E. Porter, *Competitive Advantage: Creating and Sustaining Superior Performance* (New York: Free Press, 1985).

The advantage here is of being able to model the information flows within a public sector service agency. At the level of the logistical input it will be seen that there is a wide range of information that comes from outside the unit. This means that the question of unit linkage becomes essential to discuss. It also means that decisions on vertical integration within the service have to be considered.

3. From the organizational chart and the annual budget, establish an approximate cost per unit. These figures will be approximate but will need to include salaries, building occupation costs, and consumables. More difficult will be to include the costs of the suppliers and buyers to the system, as these have generally been regarded as being insignificant. The exercise will be more effective if one can model some sort of time series into the operation. Historic data is difficult to acquire or make sense of, as organizations and their activities change over time.

4. Construct the information map of the activities. This might be seen as the value chain diagram without the participants,

just in terms of the movement of information. It might just as easily be modeled in a structured system form with logical data structures, data flow diagrams, entity life histories, and so forth,[53] but the important addition here is that each process is to be costed, even if only at the level of approximation, for aggregate and unit costs. From the problem noted above the costing will have to be internal to the organization, not a true cost to the system as a whole. Remember this is an exercise in modeling the current system, not on describing the design of the new one.

5. Model the activity cost shifts. For whatever time series you have been able to establish, model the costs per function. If information technology has been implemented in the past, then measure these costs against function. Otherwise, staff and location costs are likely to be the only major ones.

6. Now establish the information system strategy. This must attempt to gain the maximum enhancement in service with the minimum cost. These can be modeled for alternative information strategies across the value chain model and related to the corporate strategy. It might be useful to add here a classification of the activities modeled in the organizational chart as core, service, and discretionary. A series of iterations can be made, providing different qualities of change for different designs until the participants agree to an optimum. The advantage of the preparatory work is that the calculations and the perceptions of the unit linkage benefits should be much easier to model.

   What is likely is that minor applications are perceived at various stages of the development of the strategy and implemented there and then.

   The problem is whether planning, designing, and implementing an information system is an event or a process. Buying a machine is an event, getting a budget through a committee or past a senior official is an event, but they are events in a process and what is at issue is whether any one planner has a perception of the process outside the events, just as what is at issue is whether any one official can have a perception of the value chain outside his own department.

7. Select hardware, software, design prototypes, and applications, in other words standard project management, for sections of the strategy, as decisions are reached. As this paper is dealing with strategy design and implementation, I will leave the actual design and implementation of information systems for another occasion. Reference can be made to

various texts on this often trod path.54/

8. Possibly the most difficult issue of all is who designs the strategy. In many ways this determines the outcome, for the decision to design a strategy must have an origin and the allocation of the method of design and implementation is a guide to the driving force and likely outcome. There is a very strong argument for appointing an external consultant, as that organization will be able to stand outside the internal political complexities and give a relatively impartial opinion. There are a number of dangers:

   a. The consultant can have political or social links with one of the political participants. If this level of intrigue exists, then it will be impossible to achieve a functioning system.

   b. The consultant can have links with a particular vendor or software house. This is much more difficult to disentangle, but very common. Reading the formal strategy proposal can give a useful guide though, if the decision on hardware or software seems to come before a thorough analysis of the organizational issues.

   c. The use of a consultant emphasizes the event at the expense of the process, unless the consultancy is based on a long time frame; in which case the danger is that there builds up a dependency relationship which dissolves the neutrality.

   If resources are not available for an external consultant, then it rather indicates that resources will not be available for significant information technology either.

   It might be then worth considering whether some sort of consortium might be set up in order to share resources. Four London borough formed the LOLA in order to make greatest use of limited facilities and LAMSAC55/ developed so that all local government organizations in Britain might improve their information management capacity.

I hope that the paper has indicated that there is enormous scope for an information strategy with almost no resources, what I have called elsewhere "riding on the backs of others." In other words any official, no matter how junior, with the drive and determination to effect change, can start somewhere. The secret is to think big but to start small.

NOTES

1/ For example, see Brenda White, *Sourcebook of Planning Information* (London: Bingley, 1971).

2/ Jeffrey Willis, "Design Issues for Urban and Regional Information Systems" (Working paper 71) (London: Centre for Environmental Studies, University College London, 1972); United Nations Research Institute for Social Development, *Case Studies on Information Systems for Regional Development* Vol. 1: Sweden (Report 70.8); Vol. 2: Chile (Report 70.9) (Geneva, 1970); and Dept. of the Environment, *General Information System for Planning* (London: HMSO, 1971).

3/ United Nations Centre for Regional Development, *Information Systems for Urban and Regional Planning: Asian and Pacific Perspectives* (Nagoya, 1986); and *Regional Development Dialogue* 8 (Spring 1987) (Topical theme: "Training in Information Systems for Local and Regional Planning").

4/ Marvin L. Manheim, "The Third Computer Revolution: Implications for Training in Developing Countries," *Regional Development Dialogue* 8 (Spring 1987): 122-40.

5/ Patrick Wakeley, "International Strategy for Human Settlements Training in Developing Countries: The Role of International Aid Agencies" (Nairobi: United Nations Centre for Human Settlements (Habitat), 1986).

6/ Nigel Harris, *The End of the Third World* (Harmondsworth: Penguin, 1987).

7/ James Martin, *Information Engineering* 3 vols. (Carnforth, Lancashire: Savant Research Studies, 1986); Ralph H. Sprague and Barbara McNurlin, eds., *Information Systems Management in Practice* (Engelwood Cliffs, NJ: Prentice Hall, 1986); and Denis Connor, *Information System Specification and Design Road Map* (Engelwood Cliffs, NJ: Prentice Hall, 1985).

8/ David Rhind, ed., *A Census User's Handbook* (London: Methuen, 1983).

9/ John Pinfold, *African Population Census Reports: A Checklist* (Munich: Zell, 1984).

10/ Ian Bracken, "Computer Aided Cartography with Microcomputers: A Practical Guide to Microplot" (Papers in planning research 90) (Cardiff: UWIST Department of Town Planning, 1985); and Bill Campbell, *MAPPICS* (London: UCL Dept. of Geography, 1985).

11/ Raymond Vernon, *Metropolis 1985: An Interpretation of the Findings of the New York Metropolitan Study* (Cambridge, MA: Harvard Univ. Press, 1960); and Peter Hall, *The Containment of Urban England* (London: Allen and Unwin, 1973).

12/ David Casley and David Lury, *Data Collection in Developing Countries* (Cambridge: Clarendon, 1981); and Martin Bulmer and David Warwick, *Social Research in Developing Countries: Surveys and Censuses in the Third World* (Chichester: Wiley, 1982).

13/ Chorley Committee, *Handling Geographic Information* (London: HMSO, 1987).

14/ Babar Mumtaz, *Readings in Action Planning* (London: Development Planning Unit, University College London, 1982).

15/ On privatization, see A. Siemsen's bibliography, and in particular Overseas Development Institute, *Privatisation* (London, 1987).

16/ EUROLOT, an expert system produced by University of Strathclyde.

17/ For a survey of the interests and institutions involved in information for development, see John Lindsay, "Information Traffic in Developing Countries: Consultancy, Marketing and Training Related Activities" (London: British Library, 1987).

18/ Robert Cassen, *Does Aid Work? Report of an Intergovernmental Task Force* (Oxford: Oxford Univ. Press, 1986).

19/ John Lindsay, "Training in Information Systems Design for Urban and Regional Planners in Developing Countries," *Regional Development Dialogue* 8 (Spring 1987): 177-212.

20/ Wakeley, "International Strategy for Human Settlements Training in Developing Countries."

21/ For a discussion of the relationship between developments in telecommunications and economic development, see Robert J. Saunders, Jeremy J. Warford, and Bjorn Wellenius, *Telecommunications and Economic Development* (Baltimore: John Hopkins University Press, 1983).

22/ For a discussion of this problem, see Nigel Harris, *Of Bread and Guns* (Harmondsworth: Penguin, 1984).

23/ Desmond McNeill, *The Contradictions of Foreign Aid* (London: Croom Helm, 1981); and Cassen, *Does Aid Work?*

24/ United Nations Industrial Development Organization, *Microprocessor Applications in Developing Countries* (UNIDO/IS 351) (Vienna, 1982).

25/ See Bulmer, *Social Research in Developing Countries.*

26/ For recent information on applications, see the *International Journal of Remote Sensing.*

27/ Jean V. Salmona, "Government Information Systems: A Tool for Development" (Background paper 11) (Expert Working Group on Modern Management and Information Systems for Public Administration in Developing Countries, New York, UN/DTCD, 12-16 December 1983).

28/ The work of the International Union of Local Authorities might be referred to here.

29/ For a discussion on this point, see Dermot Engelfield and Gavin Drewry, eds., *Information Sources in Politics and Political Science: A Survey Worldwide* (London: Butterworths, 1984).

30/ See Gary Gorman and Maureen Mahoney, *A Guide to Current National Bibliographies in the Third World* (Munich: Zell, 1983). A well-known source of information internationally is *World of Learning.*

31/ United Nations Industrial Development Organization, *The UNIDO Data Base: Primary Sources and Data Base Design* (UNIDO/IS 463) (Vienna, 1984).

32/ Joint Bank/Fund Library, *Annual Reports of the World's Central Banks, Containing the Complete Collection of the Joint Bank/Fund Library* (Cambridge: Chadwyck Healey, 1986).

33/ The UNESCO RAMP Programme within the General Information Programme Division (PGI) has done considerable work on this aspect.

34/ For a discussion of these issues and a checklist on activities being undertaken in Europe, see John Lindsay, "Data-Bases and Networking for Development: The Organisation of Information in Europe in the Field of Policy and Planning for Developing Countries" (Paris: UNESCO, 1985). For a discussion of the activities of UNESCO, particularly its PGI Programme and its Universal Availability of Publications (UAP) Programme, see Stephen J. Parker, "UNESCO and Library Development Planning" (London: Library Association, 1985); see also the *UNISIST Newsletter*.

35/ The Overseas Survey of the British Ordnance Survey is an example.

36/ Ian D. Harrison, *Basic Bibliography on Postcodes and Postcode Applications* (London: Faculty of Computing, City of London Polytechnic, 1987).

37/ Still free and a useful source of information is the UNIDO *Microelectronics Monitor*. Not free, but cheap is the *BURISA Newsletter* which has the advantage of also giving accounts of applications. The Newsletter is published by the British Urban and Regional Information Systems Association, School of Advanced Urban Studies, Bristol. Though a little dated now, John England et al., *Information Systems for Policy Planning in Local Government* (London: Longman, 1985) gave a useful summary of the state of the art at the time of publication.

38/ Planning and Development Collaborative International, *"The Bertaud Model": A Model for the Analysis of Alternatives for Low-Income Shelter in the Developing World* (Washington, DC: World Bank, 1981).

39/ UNCHS (Habitat).

40/ Graham Pyatt and Alan Roe, *Social Accounting for Development Planning with Special Reference to Sri Lanka* (Cambridge: Cambridge Univ. Press, 1977).

41/ UNCHS (Habitat), *Data Management for Urban and Regional Development* (Nairobi, 1981); *Data Management: User's Manual* (Urban Data Management Software) 2nd ed. (Nairobi, 1983); *Data Management: Instructor's Manual* (Workshop on Data Management for Human Settlement Development) (Nairobi, 1983); see also John R. Ottensmann, *BASIC Microcomputer Programs for Urban Analysis and Planning* (New York: Chapman and Hall, 1984).

42/ T. Aspden et al., *Kingston Upon Thames: A Census Atlas* (19 v.) (Kingston Upon Thames: School of Geography, Kingston Polytechnic, 1986).

43/ MAPPICS is a package for combining digitized data with statistical data, developed at University College London in the Dept. of Geography.

44/ SORSA organizes international conferences.

45/ UDMS, held every two years, usually in Europe, publish their proceedings; the most recent was at Blois.

46/ John Rose of UNESCO has been working on evaluating packages with the Institute for Coastal and Offshore Research, Visakhapatnam, India.

47/ John Lindsay, "Networking and Development: A Feasibility Study for the Social and Human Sciences Division of UNESCO into the Development of Networking Facilities in the ECA and ECWA Regions" (Paris: UNESCO, 1986).

48/ Karel Riha and George Rzevski, "Computer-Aided Design of Software: Research and Experience" (Automating Systems Development International Conference Proceedings, Leicester Polytechnic, 1987) (Research paper series 87-2) (London: School of Information Systems, Kingston Polytechnic, 1987).

49/ Martin, *Information Engineering*.

50/ Sprague and McNurlin, *Information Systems Management in Practice*.

51/ Mumtaz, *Readings in Action Planning*.

52/ Michael E. Porter, *Competitive Advantage: Creating and Sustaining Superior Performance* (New York: Free Press, 1985); and his *Competitive Strategy* (New York: Free Press, 1980).

53/ Mike Goodland, *Structured Systems Analysis and Design Method: A UK Government Standard* (TC8) (Budapest: IFIP, 1987).

54/ See Martin, *Information Engineering*; and Sprague and McNurlin, *Information Systems Management in Practice*.

55/ *LAMSAC Bulletin* (London) is useful for keeping up-to-date in applications.

19

STRATEGIES FOR DEVELOPING AND IMPLEMENTING INFORMATION SYSTEMS IN PUBLIC ADMINISTRATION: FROM CLASSICAL INFORMATICS TO NEW INFORMATION TECHNOLOGIES

Jean V. Salmona

INTRODUCTION

The role of public administration in the economy and society is developing in most countries as the demand for free services (education, health, and social services) increases. Meanwhile, the worldwide economic crisis and the growing complexity of social and economic structures call for more regulations.

At the same time, no country, region, or city, could stand an increase in the cost of public administration, direct and indirect (e.g., for enterprises, the cost of activities made necessary by administrative regulations, such as filling in forms), without jeopardizing the competitiveness of its economy.

Public administration is therefore bound to increase its productivity much quicker than the productivity of the whole economy, and at the same time improve the quality of services to the public.

As the main activity of most public administration services is to process information, this implies that the use of information technologies should develop at a faster pace in public administration than in the other parts of the economy.

However, the use of information technologies has been developing for the last twenty years in public administration without significant increases in productivity, improvement in public services, or reduction of the administrative burden on enterprises. In many cases, the costs of administrative routines have even increased. This is mainly due to the fact that information technologies have been introduced in public administration as well as in businesses without proper strategies, and under the pressure of hardware and software manufacturers, and that at the same time administrative structures and procedures have not evolved.

As the new information technologies are penetrating public administration as well as businesses faster than the classical computer technologies, the need for strategies is becoming more and more obvious.

The general objectives of such strategies should be: to make the best possible use of available resources, to avoid duplication in data collection, to give every user the data and the tools he/she needs to perform his/her functions, and to increase productivity and efficiency in public administration, e.g., through major changes in organizational structures and procedures.

GENERAL PICTURE OF INFORMATION SYSTEMS IN PUBLIC ADMINISTRATION

Information systems in public administration comprise two main categories: large management information systems which are centralized, and networks of decentralized workstations.

Large management information systems are necessary in public administration for such functions as civil registration, taxation, and land registration. They have to be centralized for obvious reasons, but it does not necessarily mean that they have to be physically centralized: they can be organized into distributed data bases, depending on the users' needs. Centralization may be organized at the central government level (e.g., generally the population registers), at the regional level (e.g., enterprise registers), and at the urban or district level (e.g., land-use information systems).

There is a basic difference between an information system for management of administrative operations and an information system for decision making. Decision making information systems generally (but not always) deal with aggregate data, while management information systems generally deal with individual data.

Information systems for planning and decision making can be -- as they have been in the past -- large systems running big models on mainframe computers (e.g., for national planning). But the new software packages available for modeling and decision making on microcomputers, the most simple being spreadsheets (such as MULTIPLAN and LOTUS 1-2-3), make it possible for users to retrieve data from a system and to use such data for decision making and, more generally, to run planning and decision making systems on their own microcomputer, as long as they do not require sophisticated models.

More precisely, the development of microcomputers makes it possible for the user to have his/her own computer files and software packages on his/her desk. By using the computer as a terminal, he/she can have access to the various information systems he/she needs. Besides, he/she can use his/her computer for local data processing, for file storage, and for functions such as word processing and electronic messages. All these workstations are therefore organized into networks, which can be local area networks (e.g., network inside a building) or larger networks (e.g., in a department of the central government or in a municipality).

Besides, units outside public administration may need to have access to some of the information systems in public administration. This is the case, for instance, for enterprises which supply data to public administration or which need some data stored by public administration. For example, in many European countries, the customs formalities are processed directly by the concerned enterprise through a terminal run by the Customs administration.

The organization of information systems in public administration is, therefore, no longer a set of isolated management information systems with terminals, but a huge set of networks.

COMMUNICATION AND THE NEED FOR STANDARDS

From his/her workstation, a user should be able to retrieve data from a mini or mainframe computer, and to exchange data with other workstations. This means that it is no longer necessary to store the same set of data in different computers: Data can be stored only once, provided the user could gain access to it.

Communication between computers, between workstations and computers, and between workstations, is now the main issue. Although obviously not all data should be used by all users, the hardware, software, and network should be organized in such a way that constraints to communications are avoided; however, access may be restricted through the use of security devices (hardware and software) and keys.

The first element of the strategy lies in the definition and enforcement of standards.

Data Standards

The data standards issues have been described in the Government Data Network (GDN) approach as defined by the Data for Development International Association and adopted by the United Nations Economic and Social Commission for Asia and the Pacific (ESCAP) (together with many countries in the world). Quantitative data in public administration relate to the basic entities such as individuals, enterprises, and land parcels. The Government Data Network approach to quantitative data can be described briefly as follows:

- Each entity (enterprise) should be registered and allocated an identification number and maintained in an identification register. The identification number will be used in all administrative files related to that entity.
- For each entity a given set of data is collected by the most appropriate agency and placed at the disposal of other concerned agencies and users.
- It is possible to gather data from various sources related to the same entity, to exchange data among different departments, to build cross-tabulations, and to provide aggregate data for decision making.

The Government Data Network, which is based on centralized identification registers for individuals, enterprises, land, roads, superstructure and infrastructure networks, buildings, and other facilities, also provides standards for nonquantitative data, e.g., text information.

Network Standards

Generally speaking, two different computers are unable to communicate, unless a specific network system has been built for that purpose. To make it possible for all computers and workstations to communicate, one should adopt network standards. Up to now, each hardware manufacturer has been building its own network system, to make it difficult for other computers to be introduced into the network and therefore to keep its clients tied to its own hardware. International network standards have now been defined and the most commonly used network standard is the European (Open System Interconnection (OSI)) standard. Therefore, it is highly recommended that any central, regional, or local government strategy enforce the OSI standards before buying any hardware equipment, in order to allow competition between the various hardware manufacturers.

Software Standards

Basic software standards are needed to ensure an exchange of application software (e.g., for microcomputers, the MS-DOS operating system is a *de facto* basic software standard which makes it possible for two personal computers using that system to exchange application software.

While some application software standards cannot be enforced at all levels of public administration, at least some can be enforced in the same unit. For instance, if one word processing package is set as a standard, all individuals using that package will be able to exchange floppy disks or texts through their workstation and modify or complete them regardless of the workstation.

From a strategic point of view, there is a need for consultation between users, data specialists, and hardware and software specialists with reference to the definition and enforcement of these standards, the organization of communication, and the decision concerning which workstation should have access to which information systems and which workstation should communicate with which workstations.

Three Examples of Information Systems Involving Networks

First example: Processing of the Minister's mail in the Department of Industry, France

The present Minister of Industry wanted to increase the efficiency of the processing of his personal mail and that of the parliamentary attaché service. He was mainly aiming at two objectives: To be able to write to any of his usual correspondents (around 2,000 leaders in the country) in a personalized way; and to process as quickly as possible the incoming mail from any of these correspondents and from the opinion leaders.

The Centre d'Etudes des Systemes d'Information des Administrations (CESIA) designed and implemented a system, which is based on a small local area network (LAN) of BULL microcomputers, BM60 and 30. One of the micros runs a data base of the Minister's correspondents (opinion leaders) with their addresses, various characteristics, and especially the formulae to start and complete the letters, which are personalized for each of the correspondents. This data base is permanently updated.

The incoming mail is processed in the following way. Any letter coming from one of the correspondents is first registered in the incoming mail data base, and the subject of the letter is directly entered in the data base by one of the Minister's assistants. The system immediately produces a personalized letter to the correspondent acknowledging receipt, mentioning the subject, and indicating that a reply will be sent soon. The letter is produced by a laser printer, and is sent within twenty-four hours. The system produces a transmittal form which is attached to the letter and sent to the appropriate unit for reply. The form indicates the deadline for replying to the letter. If a reply has not been sent, the system produces an automatic reminder which is immediately sent to the concerned unit, indicating that the deadline is past and asking the unit to send the reply within twenty-four hours. At the same time, the Minister's assistants are asked to follow up the reply. When the acknowledgement letter is sent to the correspondent, a copy, together with a standard letter is sent to the *Prefect* (Governor) of the region where the correspondent is located to inform him that the correspondent has shown an interest in a specific subject. The system is a small area network between the Minister's secretaries and political assistants. The second phase will involve direct teletex transmission between the units and the Minister's Office.

This small, simple, and cheap system has resulted in a simplification of mail processing and a reduction of delays in sending replies to the Minister's correspondents. Moreover, the system has enabled the Minister to send personalized letters informing the correspondents in a particular region of his forthcoming visit.

Second Example: Information systems for rural planning at the district level, Sri Lanka

This pilot project, which was a joint Data for Development/ ESCAP/UNESCO/Government of Sri Lanka project, aimed at giving the local authorities a possible administrative management system and a planning system at the district level, and at enabling the central government to gather data from the various districts for use in planning and decision making at the central level. One microcomputer was used at the district level to process administrative data on individuals and enterprises. The data standards were established at the national level by the Central Statistical Office. The functions for local planning, including application software, were created for use at the local level depending on the specific problems of the area. Later, the system will be made part of a national network linking each district to the central level and enabling the district to send data to the central level and to retrieve data from the central data bases (e.g., data on technologies and national statistics).

Third Example: Network between public administration and enterprises, France

A recent study made by CESIA in France showed that the marginal cost of the time spent by enterprises for filling in forms in public administration is estimated at around Fr14 billion per year. A programme has been set up by the government to reduce that burden for enterprises in order to help them limit their overheads and therefore increase their competitiveness. Two projects have been launched and are now operational.

The first project relates to the annual transfer of social data, i.e., data on employees and salaries. Until recently, each enterprise had to fill in various forms with the same data and forward them to various administration services: Social Security, Statistical Office, Tax Administration, retirement funds, etc. While most enterprises and all administration services are computerized, the data are entered, retrieved, and transmitted by paper, separately by each enterprise or service.

This costly and duplicative procedure has been replaced by a very simple one. Any enterprise is now allowed to send either a magnetic tape or a floppy disk with a fixed format to a central agency of the Social Security unit, which processes it into separate files for transmittal to the various administration services. Each service receives only the data it needs. As a next step, the data will be sent through a data network, with decentralized private or public bodies playing the role of interfaces between the enterprises and the central Social Security unit, in order to control the data before dissemination.

One should mention that the main problems were of course not technical, but data standardization: One had to convince all the services' data users to agree on common concepts and on a common set of data standards, which took more than two years.

At present, one-third of the French workers are covered by the new procedure. The Tax Administration has been able to save 1,500 jobs due to automation.

A second interesting project in the same area is the organization in a county in the south of France (Bouches-du-Rhône) of an electronic videotex system between enterprises and public administration services (such as Tax Administration, Customs, and Social Security). The public administration has a commitment to reply to any message within two days at the maximum, and has always kept the deadline. The result is that enterprises, instead of calling or writing to public administration services or visiting them, send messages from their videotex terminal (given free of charge by the Telecommunications Agency) and after two days at the maximum retrieve the data from their electronic mail box.

Enterprises can send messages any time of the day, including weekends. Besides, enterprises can send messages from any point and not necessarily from their own terminal, provided they have access to the system.

The next step involves the use of videotex forms. A smart-card system annexed to the videotex terminal will allow managers of enterprises to sign and authenticate the forms.

METHODOLOGIES, ORGANIZATIONAL STRUCTURES, CONCEPTS, AND PRACTICAL WAYS TO DESIGN AND IMPLEMENT INFORMATION SYSTEMS

Methodologies

Methodologies are needed and used for the strategic planning, design, and implementation of information systems, and for other purposes (such as preparing the terms of reference for a call for tenders).

Among the methodologies for the strategic planning of information systems are the French RACINES and the American Business System Planning (BSP). These methodologies have two advantages: the first is to provide the strategic planners with a tool for planning the information systems according to the needs of the users and to continue developing such systems as the needs of the users evolve; and the second is to have a unified way of planning the information systems in the same department, municipality, or government administration (interdepartmental control and coordination of information systems in public administration).

Methodologies for the design of information systems include the French MERISE (a CESIA methodology), the British SSDAM (built by CCTA), and the Italian DAFNE.

Methodologies for information systems project management include the French MCP and the British PROMPT.

It should be pointed out that in order to adopt a unique methodology for the design of information systems (such as MERISE) in one organization, it is essential to develop a common culture among information technology specialists and the users in the organization.

Organizational Structures

As previously mentioned, organizational structures and related procedures should evolve as information systems are developed: First, because the use of information technologies makes it possible to improve the organizational structures and procedures; and second, because the use of information technologies cannot be efficient if the organizational structures and procedures are not adapted to the needs of information systems. Therefore, any strategic planning of information systems should include an organizational study and plan, together with an analysis and evaluation of current procedures.

Information Resource Management

Information resource management (IRM) applies to all activities in the organization related to information, equipment and software, and manpower involved in the planning, building, and management evaluation of information systems. This concept is especially useful in large organizations where information technology related activities are spread all over the organization, and where coordination is necessary. An IRM organization may be in the form of a commission, division, or department. Its task is to programme and budget the resources allocated by the management.

Practical Methods

The strategies for the development and implementation of information systems include some practical methods which have proved to be useful. Among these, we shall mention the following:

(a) Creating awareness and training the users: first, the users should be made aware of the benefits of the use of information technologies; second, training of the users on the use of information technologies should be undertaken before the technologies are made available to them.

(b) An information technology centre within the organization is frequently useful; its task is to provide all the available information technologies, and demonstrate their use and applications to the users.

(c) The users should have a choice between various types of hardware and application software: When a standard has been defined and enforced (e.g., the PC MS-DOS standard for microcomputers), the users should be given the opportunity of choosing between different possible hardware so that the computer they eventually get will be the one they have personally chosen. This is essential for the success of information technology implementation. At the same time, the users should be given the opportunity to develop their own application software, which is now possible with the Fourth Generation languages which can be easily learned and used by any nonspecialist.

THE IMPACT OF NEW TECHNOLOGIES

New information technologies will have a much larger impact than the previous classical ones on the efficiency of public administration and business. We shall give only four examples.

Conference Calls (Teleconference)

A technology as simple as the conference call, which makes it possible to organize a telephone call between more than two individuals and therefore to avoid physical meetings, may change completely the efficiency of a given institution which has branches in many different locations and where people have to hold meetings frequently. At the same time, it will reduce travel costs. This example shows that even the most elementary information technologies may have a fundamental impact on an organization.

Videotex

The videotex standard makes it possible to link any terminal using that standard (or television set equipped with an *ad hoc* decoder) to a computer using the same standard, or to another videotex terminal. In France, a videotex standard has been adopted by the central telecommunications agency and cheap videotex terminals are distributed free of charge to all telephone users. Consequently, a wide use of data systems is now taking place among the public and many existing information systems are now accessible through videotex from any place in the country for use by individuals and enterprises. Besides, some specific applications such as computerized telephone directory, plane and train timetables, and stock exchange daily values, have been developed for that purpose.

503

Microprocessor Card

The microprocessor card, also called Smartcard, can be used for many purposes, including: identification for access to buildings; portable file (health, education); 100 per cent security of access to restricted information systems and data bases; and means of payment, e.g., credit cards with 100 per cent security of access.

The microprocessor card is the best way to replace signatures when the exchange of documents is replaced by the exchange of electronic data through workstations.

Expert Systems

In public administration, and especially in a given field (e.g., land taxation) where there are few specialists, the use of expert systems offers the possibility of increasing the efficiency and productivity of public administration. In some cases, it is desirable to utilize the knowledge of some expert civil servants in very specialized fields before they retire. This will enable the younger employees to gain knowledge from the senior employees.

New technologies are cheaper than classical computer technologies; they are user-friendly; and they can be used directly by the users without making it necessary for a specialist to be permanently involved in the management of technology application.

CONCLUSION

In France, it is envisaged that all enterprises -- including family-owned one-man enterprises -- will be computerized, i.e., they will have their own computer by the year 1992. In public administration, each civil servant will have a workstation on his/her desk and in some cases a second portable workstation before the year 1995. A value-added network will make it possible to generalize the data exchange between enterprises and public administration and replace the forms traditionally filled in by enterprises. Information technology applications will change public administration in the next few years.

These changes are not basically technical; they are in fact organizational and they affect the nature and the number of jobs in public administration. The situation is the same in business. These developments cannot and should not be hindered: The productivity of public administration and the competitiveness of the nation's economy demand it. But these will succeed only if attention is given to the key unit in the whole process: the individuals who are concerned with the use of that technology. Techniques such as quality circles have proved to be very useful in that respect.

Here, as well as in other sectors, Man is the major point on which attention should be focused.

20

EFFECTIVE INFORMATION SYSTEMS STRATEGIES FOR THE GOVERNMENT SERVICE: THE SINGAPORE EXPERIENCE

Ko Kheng Hwa

BACKGROUND

Singapore

Singapore was a former British colony and later, a Malaysian state. It became a republic in 1965 after gaining independence. About 2.6 million people comprising Malays, Chinese, Indians, and other ethnic groups live in an area of 620 km^2. The average life expectancy at birth is seventy-one years. The literacy rate of the population is estimated at 86 per cent. In 1985, the GNP per capita was about US$6,700. In terms of computer usage, Singapore has 0.3 mainframe and minicomputers per 1,000 population and an information technology (IT) expenditure of US$96 per 1,000 population (compared to 1.5 and US$72.4, respectively, for Japan).1/

The Government

Parliament is unicameral and consists of seventy-nine members elected by the people in single member constituencies. Judicial power is vested in the Supreme Court and subordinate courts. The judiciary administers law independently of the executive. The President, who is elected by Parliament, appoints a Member of Parliament as Prime Minister. There are currently fourteen ministries, each headed by one or more ministers.

The Civil Service has about 70,000 employees (about 6 per cent of the work force) in the ministries and several organs of state. In 1985, government expenditure totalled US$6,000 million, nearly half of which was development expenditure.

The National Computer Board

The National Computer Board (NCB) was set up in September 1981 as a statutory board under the Ministry of Finance. Its mission is to drive Singapore into the information age. Its role is to promote the exploitation of information technology in Singapore to improve productivity and enhance business competitiveness in the various economic sectors; and to develop a strong and viable export-oriented IT industry. One of NCB's major functions is the management and implementation of the Civil Service Computerization Programme (CSCP).

Singapore has formulated a national IT plan as an integrated strategy to fully exploit the potential of IT. The NCB has been given the responsibility of a central coordination agency in the implementation of this plan which aims to:

(a) Produce high quality IT manpower;

(b) Promote a supportive IT culture;

(c) Maintain an excellent information communication infrastructure;

(d) Encourage widespread IT application in all sectors;

(e) Build a strong IT industry;

(f) Develop a climate for creativity and entrepreneurship; and

(g) Forge close coordination and collaboration among all relevant agencies to achieve unity of purpose.

HISTORICAL PERSPECTIVE OF GOVERNMENT COMPUTERIZATION

The Civil Service started computerization in 1964. Prior to the formation of the NCB in 1981, the Civil Service adopted a centralized approach to computerization. Most government ministries relied on a central department for data processing (dp) services. Under this approach, computerization progressed at a relatively slow pace as the central dp department had insufficient professional resources, skills, and technology and was unable to cope with the varied and growing demands of its users. Consequently, there were many frustrated and unhappy users and a huge application backlog.

EFFECTIVE INFORMATION SYSTEMS STRATEGIES

The Committee on National Computerization (CNC) chaired by Tony Tan, the then Senior Minister of State for Education, commissioned a study in 1980 to look into the long-term computerization requirements of the Civil Service and to recommend an action programme for its implementation. The study was carried out concurrently by several teams, comprising data processing professionals from the central department and the Ministry of Defence, management services officers from the Ministry of Finance, and senior officers from the various ministries. The results of their studies and their recommendations were published in a Civil Service Computerization report in 1981 which was subsequently accepted by the CNC.

This led to the formation of the NCB and the formulation of the CSCP which was to have a tremendous impact on the way the Government of Singapore would make use of IT to improve the efficiency and effectiveness of its public administration.

THE CIVIL SERVICE COMPUTERIZATION PROGRAMME

The CSCP, which was launched at the end of 1981, is a multimillion dollar programme to promote the use of computers and implement computerized information systems in every government ministry. The initial scope of the CSCP covered eighty-nine application systems in ten ministries. The CSCP was, however, to be an evolving programme. It expanded in scope to cover new application areas within ministries and to cover new ministries, and extended to continually exploit opportunities presented by new and emerging technologies.

The CSCP was to spearhead the national computerization effort and demonstrate the government's strong commitment to computerization in the early eighties. The programme was conceived with the following objectives:

(a) To increase the productivity and effectiveness of government operations;

(b) To improve the level and range of government service to the public; and

(c) To create interest and promote computer usage in other economic sectors through the operation of new and very visible computerized systems in the Civil Service.

CHALLENGES FACING THE IMPLEMENTATION OF THE CSCP

The implementation of the CSCP was a challenging task. Initially, the odds were against us. We faced a number of major issues and concerns which are discussed below.

Mammoth Task

Owing to the huge application backlog and the fact that no ministry was prepared to wait, we decided to implement the computerization projects in ten ministries concurrently although not at the same pace. The speed of implementation in each ministry depended on the nature of the application systems, availability of professional manpower, and readiness of users. Nevertheless, starting up in-house information systems departments in ten ministries simultaneously and managing them was a mammoth task compared to the limited computerization activities of the centralized approach in the pre-CSCP era.

Sophisticated Systems

Many of the application systems identified in the CSCP were large and complex requiring on-line data base and data communications technologies to implement. Examples of such systems were a real-time command and control system for police, fire, and ambulance services, a health care network linking up the major government hospitals, and an integrated land-use and mapping system for the country. High calibre and experienced staff were needed to implement the systems. These systems contrast sharply with the mainly batch systems that the Civil Service used prior to the CSCP.

Limited Manpower and Expertise

There was an acute shortage of manpower and expertise in the government to implement the CSCP. The then existing professional staff in the government was insufficient to service the central dp department, let alone the ten information systems departments in the CSCP. The industry also lacked qualified manpower, especially those who had experience in implementing complex systems using the latest technology. In fact, the whole of Singapore had only about 800 computer professionals in 1980. We also did not want to stifle the growth of the computer industry and computerization in other economic sectors by directing their experienced professional resources to the government.

New Users

The CSCP resulted in hundreds of new potential users of information systems. Most of them were completely new to the computerization process. They had little experience in performing the user roles effectively in the systems development life cycle. For example, many users were reluctant to sign off each phase of the systems development because they had yet to see the real system working before their eyes. Some users felt uncertain over the impact that the new technology might bring to the workplace. Others were overly enthusiastic and set unrealistic expectations.

Changes in Work Methods

Computerization would have tremendous impact on the way in which the government departments would operate. There would be substantial changes in work methods, office procedures, and delivery of public services. There would be staff redeployment and redefinition of work roles. There was concern over the extent to which the organizational inertia of the Civil Service would hinder such changes and, hence, the progress of the CSCP implementation.

No Model to Emulate

There was very little experience in other countries which we could draw upon in formulating our strategies for the CSCP. There was virtually no overseas model for us to study or emulate.

Positive Factors

On the more positive side, there were two major factors working in favour of the CSCP, namely:

(a) There was a highly visible and total commitment from the government to computerize its operations as demonstrated by the formation of the NCB and the launching of the CSCP.

(b) There was strong pressure on government departments to improve productivity, particularly by reducing staffing through automation and computerization, and to upgrade the level of public service.

IMPLEMENTATION STRATEGIES

We formulated seven key strategies in the implementation of the CSCP which took cognizance of the issues, concerns, and environmental factors discussed previously. These strategies are elaborated below.

Balance between Centralization and Decentralization

In the CSCP, we strike a fine balance between centralization and decentralization to obtain the best of both worlds. We adopt a strategy of decentralizing computer resources to the ministries. Computer systems will be installed in the ministries whenever justifiable. Each CSCP ministry has set up a computer information systems department (CISD) which is headed by a director from the ministry. The CISD plans, develops, implements, and operates information systems for the ministry. Under the director are the NCB professional staff assigned to the ministry. These staff include information systems managers, systems analysts, and programmers. However, professional resource management (including recruitment, deployment, and training), systems procurement, development of standards and methodologies, implementation of technical programmes and systems which are common to all ministries, and provision of second-level specialist support are centrally carried out or coordinated by the NCB headquarters.

The strategy has enabled our decentralized CISDs to be responsive to the information systems needs of the ministries. At the same time, it has allowed us to reap economies of scale (e.g., procurement), reduce duplication of effort (e.g., developing one methodology to be used by all ministries), implement Civil Service wide systems (e.g., personnel management), integrate and interconnect systems (e.g., NCB headquarters carries out Civil Service wide network planning and implementation), adopt common standards (e.g., system development standards), and share experiences and scarce technical resources among the ministries.

Partnership Philosophy

The CSCP is implemented under a partnership philosophy between the NCB and the ministries. This strategy is predicated on the premise that only by matching the information systems expertise and application expertise (i.e., business knowledge) would there be success in developing good information systems based on robust technical designs and meeting users' requirements. We work on the principles that the users know their business best and that the ministry's success is NCB's success as well.

Under this partnership arrangement, the ministry is responsible for justifying funds for computerization and ensuring that computerization investments bring adequate returns and are congruent with the ministry's mission and objectives. The ministry users are also expected to determine the functional requirements of the information systems and educate NCB professionals in the knowledge of their business. Finally, the ministry has to manage information as a ministry-wide resource.

The roles of the NCB professionals deployed to the ministry are to provide technical leadership and expertise, formulate information systems strategies, and select the right technologies which will enable the users to reap maximum benefits from computerization. The NCB professionals also manage the computerization projects, develop projects, develop and implement the systems according to the ministry's priority, and train the users to use the systems effectively. In addition, the NCB headquarters provide central coordination, direction, and technical support to the CSCP sites as described earlier.

Management Commitment

Top management commitment is critical to the success of computerization in the ministries. They must be convinced that computerization will help them in accomplishing their mission and be committed to provide active leadership and direction in the computerization process.

In the CSCP, the permanent secretary (who is the highest ranking civil servant in the ministry) typically chairs a high-level Information Systems Steering Committee (ISSC) which is usually comprised of departmental heads. Essentially, the ISSC formulates policies, sets directions, integrates information systems development with other organizational efforts, manages finance, reviews overall progress, and most importantly, makes sure that the ministry's goals and objectives are supported through information systems implementation. Management commitment is thus assured through the ISSC mechanism as well as through the ministry management which is responsible for justifying funds for computerization to the Finance Ministry.

Strategic Information Systems Planning

The ministry's business is to drive the information systems development and not the other way round. Information systems must therefore support the mission, goals, and business strategies of the ministry. Strategic information systems planning must also be an integral part of the ministry's corporate planning process.

We have developed a strategic information systems planning methodology to help a ministry translate its mission, goals, and strategies into information systems strategies and into a long-term information systems development plan. Under the CSCP, a ministry has to conduct a comprehensive strategic information systems planning study before embarking on major computerization projects. This study is carried out jointly by key ministry officials and NCB professionals and led by a senior ministry staff. This planning exercise will ensure that the information systems support the business of the ministry as well as the long-term integration of systems and data, and that the maximum potential for information systems implementation is identified.

User Education

Recognizing the crucial role of end-users in determining the success of information systems implementation, we have formulated user education programmes targetted at all staff levels.

For middle- and senior-level staff, we have introduced general computer education at two levels, viz., top management (i.e., permanent secretaries) and executives and managers. The topics covered in these end-user education programmes include understanding of basic computer technology, management of information resource, information systems development methodology, the role of users in all phases of the information systems development, and implementing and managing the information systems function. The key objectives of these programmes are to equip users with the knowledge to participate actively and effectively in the systems development process, to cultivate a receptive attitude towards accepting information technology and the accompanying changes in organizational methods and work procedures, and to ensure that the users' expectations from information systems implementation are realistic.

At the operational level, the professional staff in the CISD train all end-users to use the specific systems effectively. Such training is incorporated into the implementation schedule of the projects.

Framework for Data Sharing

When all the ministries are computerized, there will be tremendous benefits to be gained from interorganizational data sharing through electronic means. These benefits include reduced duplication of data capture, storage, and maintenance, more accurate and up-to-date data, and simplified and less form-filling by members of the public. However, such data sharing can only be widely implemented when the ministries' information systems are fully operational and the communication networking infrastructure is in place.

In anticipation of this eventuality, a framework for electronic data sharing among ministries was strategized early in the CSCP. Strategies were formulated to identify data items to be shared, standardize common data items, define a Civil Service-wide data architecture, specify a framework for a Civil Service-wide network, and implement data management programmes at both intra- and interministry levels.

Moving Up the Experience Curve

Early efforts were directed at building up a solid technological capability to drive the CSCP. As pointed out earlier, it was not feasible to recruit significant numbers of technical personnel from industry. Instead, we employed large numbers of fresh graduates and implemented strategies to push them up the experience curve quickly.

These strategies included:

(a) Judiciously engaging overseas consultants and experts to fill some key technical positions and transfer their skills to our inexperienced staff.

(b) Expanding the portfolio of available senior staff.

(c) Delegating higher responsibilities to high calibre and high potential junior staff.

(d) Selectively engaging supervisory staff from software houses on contract to ease our staff shortage and to guide our junior staff in project implementation.

(e) Jointly developing complex systems with vendors who bring in experience and expertise from overseas.

(f) Relying strongly on vendors' support during the initial periods, especially on newly acquired hardware and software products.

(g) Investing very heavily in staff training. Our training expenditure per staff, especially in the early years of the CSCP, has been consistently way above the industry average.

STATUS REVIEW

The CSCP has made very credible progress, attesting the effectiveness of the strategies adopted. Today, 101 application systems have been completed, while another forty-three are under development. Altogether, about 200 application systems are planned to be developed in the next five years. There are now fifty mainframe and minicomputer systems manned by 350 professional staff spreading over twenty-three installations and project sites. The current annual direct expenditure on information systems activities is about US$35 million. More than 1,000 civil servants have attended our user education programmes, excluding the system-specific user training provided by the project staff.

We have succeeded in establishing a solid technological base and creating the necessary infrastructure for the Civil Service to exploit IT. We have built up a critical mass of staff with the right mix of skills. The CSCP is now poised to meet new challenges and changes ahead.

FUTURE DIRECTION

Five years after the launching of the CSCP, the Civil Service now has developed adequate internal capacity to exploit and manage IT for more effective and efficient public administration. But changes have occurred both in technology and in the society and the economy. Information technology, which encompasses computer technology as well as telecommunications and office systems, is rapidly creating new opportunities to raise productivity and the people's quality of life.

The national IT plan has highlighted the need for the Civil Service to adopt a more integrated perspective to exploit IT, to raise efficiency and effectiveness, and to provide higher-level and wider-ranged services to the public. In 1986, the NCB, in collaboration with senior civil servants, discussed and formulated new strategies for the CSCP to realize the full benefits of IT. Ten strategic thrusts have been identified which constitute a new strategic framework to chart a new course for the CSCP.

The strategic thrusts are summarized as follows:

(a) A Mission Orientation

To orient the users to apply IT to achieve the goals and objectives of the Civil Service, and not just to improve administrative efficiency.

(b) An Extended IT Portfolio

To encourage the Civil Service to exploit new opportunities created by technologies such as office automation, personal computing, networking, and artificial intelligence, while at the same time further stretch the mature technologies of data base and on-line transaction processing systems.

(c) "Venturism"

To encourage a spirit of innovativeness and courage in the use of IT within the Civil Service so that new opportunities in IT which can bring about large benefits are not missed for want of foresight or funds.

(d) Systems Integration

To reap the full benefits of IT by interconnecting systems for sharing data and IT resources, and so provide a streamlined and unified interface for the public to tap into the Civil Service's information systems.

(e) IT Culture

To develop awareness and appreciation for the capabilities of IT so as to dispel fears, encourage acceptance of changes and new technologies, and foster growth and development within the Civil Service.

(f) Synergistic Partnership

To foster greater collaboration between ministries and departments so that information systems which cut across the entire Civil Service are identified, developed, and implemented for the benefit of the government and the public.

(g) Information Communication Infrastructure

To put in place an infrastructure which will enable systems integration to support the implementation of integrated interministry systems and enable controlled public access to Civil Service systems.

(h) Professional Excellence

To maintain our vigil on professional standards, and forge even greater excellence so that the Civil Service can have the best systems and facilities for its investment in the CSCP.

(i) Opportunities for the IT Industry

To leverage on the CSCP to provide opportunities to the IT industry to strengthen its expertise base, and develop its export potential by providing more opportunities for the participation of the private sector in the CSCP.

(j) CSCP -- A Competitive Advantage

To create a competitive advantage for Singapore by improving the efficiency, effectiveness, and delivery of public services through the widespread and creative exploitation of IT in the Civil Service.

These strategic thrusts constitute a blueprint for the CSCP and provide the Civil Service with a new mandate to further exploit IT in an endeavour to create a better society for Singaporeans in the 1990s.

NOTE

1/ The data source is the Mitsubishi Research Institute.

21

STRATEGIC USE OF INFORMATION SYSTEMS AMONG JAPANESE PRIVATE CORPORATIONS

Moriaki Tsuchiya

INFORMATION SYSTEMS EXPECTED TO STIMULATE DOMESTIC DEMAND

Faced with a high yen and trade friction, Japan has to make its economy less dependent on the export of mass produced goods and more dependent on domestic demand. Further utilization of information systems is expected to greatly stimulate domestic demand. Many companies are focusing efforts on the development of new information systems in order to increase their competitiveness.

It is said that in Japan manufacturing industries have reached the mature stage, and that the age of a service and software economy has arrived. The tertiary industry has increased in importance, and software has even become important for adding value to products of the secondary industry. The needs of the consumer market are diversifying, and a greater variety of goods must be produced and delivered in smaller lots.

The total value of the products of the so-called information/communications industry (electronics hardware, software, and telecommunications and other communications businesses) was approximately US$280 billion in 1985, and is expected to increase to US$500 billion by 1991. Total consumer expenditures for information and communication were US$19.7 billion in 1985, and are expected to be US$31.4 billion by 1991. Total investment in information and communication facilities was US$61.8 billion in 1985, and is expected to be US$112.3 billion by 1991. The information/communications industry is already the largest industry in Japan.

STRATEGIC USE OF INFORMATION SYSTEMS

A BRIEF HISTORY OF COMPUTER UTILIZATION IN JAPAN

The role of the computer in rationalizing the office and the factory during the past three decades has been enormous. One result of computerization is that the increase in the number of employees in the manufacturing industries has not kept pace with the rapid growth in production.

In the 1960s, the computer was introduced for routine office work and production processes. Its impact was much greater in the factory than in the office. With the computer, both process automation and mechanical automation were made possible, which, in turn, paved the way for Japanese development of robotics and the flexible manufacturing system (FMS). The computer has also contributed to the development of some Japanese management systems, for example, the just-in-time production system of the automobile industry. Furthermore, the computer has fostered important technological innovations, such as continuous casting in the steel industry.

The computer did not give any one Japanese company a special competitive edge over the others because many top firms were simultaneously promoting computer utilization in their factories. The computer soon became a common part of the infrastructures of those companies. At this stage, the computer became a competitive weapon in world markets for Japanese manufacturers in general.

Mainframe computers and telecommunications were, of course, beyond the budgets of small businesses. Some small businesses, in industries where large competitors were armed with the computer, managed to somehow survive. For example, in the mid-1970s, large city banks began to introduce automated teller machines (ATMs). Small local banks, such as farmers' cooperative banking companies, could not afford the machines, which cost more than US$50,000 each. So they depended on close personal relationships within local communities for communication purposes, to compensate for the increased competitiveness of larger banks.

It was also in the mid-1970s that large wholesalers and retailers began using computers for point-of-sale (POS) information. It was questionable, however, whether POS information systems increased their competitiveness because they had to invest much capital in hardware and software and sometimes operators did not understand how to use POS information to increase profits.

There were exceptions. Seven-Eleven Japan, a large chain of convenience stores, succeeded in utilizing POS information in merchandising and in creating displays by dispatching instructors to stores. Another exception was Pharma, a voluntary organization of local pharmacies, which linked members via public telephone lines to a host computer for the exchange of sales promotion ideas.

Since the late 1970s, however, personal computers have been widely used by offices to coordinate intracompany functional activities. Many manufacturers and distributors are using small computers for inventory control. Some companies have even succeeded in creating a just-in-time distribution system, which has slashed their distribution costs.

Many companies desiring to establish a networking system discovered that the cost of telecommunications was prohibitive. In 1977, Sunlit Industries, a small apparel maker, implemented a networking system using one office computer and one NTT telex for its seven district branches. In 1980, Sunlit decided to enlarge its networking capacity, but the company was informed that the monthly rent for a personal circuit was more than US$3,000. The rental of ten circuits would have cost US$400,000 a year, more than their annual profit. So they abandoned the project to expand their network. The telecommunications cost was one obstacle to networking within small- and medium-sized companies.

NEW ERA OF NETWORKING

In 1982, the Public Telecommunications Act was liberalized to allow a group of small businesses to use one circuit cooperatively. This was the beginning of value-added networking (VAN) for small businesses.

In 1985, the telecommunications industry was further deregulated by the epoch-making Telecommunication Business Law, which privatized NTT, allowed new companies to enter the industry, and permitted the establishment of large-scale VAN business to enhance service between different types of computers.

Most observers thought that a new era in information networking had arrived. They expected dramatic reductions in telecommunications costs and surprising innovations in the use of information systems. NTT experimentally offered videotex communications service in Mitaka, Tokyo, to encourage greater use of information networking systems.

Big companies raced to establish their own VAN systems. Matsushita Electric Corporation implemented the Pana-Van project in 1985. Matsushita Electric used to delegate authority for purchase of computer systems to each division. As a result, the company has several kinds of computers, mainly IBM and Fujitsu Facom. Pana-Van connected the IBM and Fujitsu Facom systems on-line by fiber optics cable to establish real-time networking across Japan. Now they can adjust their production schedule according to daily reports about all kinds of products, and reduce buffer-inventory volume by the just-in-time distribution system.

Honda VAN and the Toyota Network System are also known for dramatically reducing lead time from order entry to delivery. Honda's and Toyota's policies are to assemble a car only in response to an order from a customer. Honda can deliver a car to the home of the customer two weeks after his/her placement of the order. The Toyota Network System is real-time, on-line networking between Toyota factories and their dealers. A customer can change the specifications of his/her order up to four days before his/her car rolls off the assembly line. Thus, networking provides Toyota salesmen with a powerful competitive weapon.

Kao Soap Company, a leading toiletry manufacturer, is a pioneer in distribution networking. Kao reorganized distribution channels to link the central office, factories, regional branches, and local warehouses by on-line networking. The company also organized a system to support retailers. Support salesmen visit supermarkets, inventory display shelves, and, instead of the retailers, place orders, on the spot, with regional branches via a portable terminal. Networking has helped Kao increase its market share on some products. Responding to the success of Kao's networking, in 1985, twenty-two competitors and 175 wholesalers jointly organized a toiletry-industry VAN, called Planet. They are networking for automatic entry of orders.

Chain store retailers and large trucking companies have jointly established VAN systems. After Itoyokado, one of the biggest chain stores in Japan, analyses POS data from their stores, they order some items directly from large wholesalers and place orders for other items with the Nitsu information service centre of Nippon Tsuun Company, one of the largest trucking companies in Japan. The service centre passes the orders to trucking stations, to Nippon Tsuun warehouses, and to small wholesalers. Manufacturers' VANs, trucking companies' VANs, wholesalers' VANs, and retailers' VANs are jostling with one another along the same distribution routes as they compete to obtain the most efficient just-in-time distribution activities.

Small wholesalers cannot wedge themselves into these crowded systems. The Ministry of International Trade and Industry reports that in 1985, there were 5.4 per cent fewer retailers and 3.7 per cent fewer wholesalers than in 1982. This was the first decrease in retailers and wholesalers since the end of the Second World War.

HORIZONTAL NETWORKING SYSTEMS

The recent progress in information technologies poses a problem for small retailers and wholesalers. Questionnaires distributed among those companies reveal difficulties in using computers. Although hardware is becoming less expensive, it is still beyond their budgets. Some calculations show that minimum sales to warrant investment in a stand-alone computer and POS registers are about US$1 million annually. These companies also have difficulty in procuring the human resources to develop the software and to do the other things necessary to achieve maximum utilization of computers.

Some local retailers and wholesalers do not like to participate in networking systems organized by big manufacturers or national wholesalers, because they think that such systems solely benefit the organizers. Small wholesalers and retailers dislike being controlled by big organizers through information networking. They are reluctant to reveal information about themselves, though they want to fully utilize their own information systems.

In March 1986, thirty-one local wholesalers and supermarkets in Shizuoka Prefecture cooperatively and voluntarily organized VAN systems, generically called Orion, for ordering merchandise. Membership in Orion has already grown to seventy-two wholesalers and 147 retailers. Orion enables Shizuoka wholesalers and retailers to collect local marketing information and to increase their bargaining power vis-à-vis manufacturers and national wholesalers.

Local wholesalers in other prefectures are attempting to emulate the success of Orion by organizing their own networking systems. If manufacturers' systems can be described as vertical networking systems, local voluntary systems can be described as horizontal networking systems. Today, large manufacturers and national wholesalers must take these horizontal systems into consideration. Some large manufacturers must even participate in the systems as regular members.

Horizontal networking systems are not restricted to distributors, but may also include small- and medium-sized manufacturers. In January 1987, twenty-five small factory automation companies in Greater Tokyo organized FACONET. Each member of this networking system has a technical specialty, for example, designing patterns for printed distribution boards, measuring, controlling mechanical processing, or software. They plan to jointly receive factory automation orders and to exchange technology in order to develop new products.

Some small manufacturers have traditionally been subcontractors under the wing of big companies. Subcontractors come under the exclusive control of a large manufacturer when it establishes a vertical networking system with suppliers. FACONET was the way one group of small manufacturers gained leverage against the vertical networking of large companies.

While the aim of a vertical networking system is to reduce lead time or distribution costs, the goal of a horizontal networking system is the creation of new business or new products. When a member of a horizontal system receives an order which it lacks the technology to fulfill, it can still accept the order, because it can request through the networking system the assistance of another member company. The only condition for the establishment of a horizontal networking system is that each company must possess know-how or specialized basic technology of high repute among the other prospective members.

SUMMARY

Information systems are assuming a strategic importance for many companies, enabling them to maintain or gain a competitive advantage. Developments in information and telecommunications are changing the industrial structure. The trends of falling costs of computers and communications services are making more and more uses of information systems both economically and technically feasible in manufacturing companies. In the longer term, more applications will also be feasible for smaller businesses.

PART V: THE ADVANCED INFORMATION CITY

22

TECHNOLOGY FOR PEOPLE: A CAMPUS CITY GUIDE

Peter Droege and Team

uchi

> the concept of 'my house', 'my family, community, people, my world' lies at the heart of the ideas presented here. It is the idealized vision of Japan within the world, the city within Japan, different communities within the city, groups within communities, individuals within groups, and different ideas within individuals. The symbol of Kawasaki City represents this concept so very well.

IDENTITY: INTELLIGENCE AND TRANSPARENCY

This is a guide to Kawasaki's transformation into an advanced information city, a city advanced first of all in its human and social ideas.

It shows how technological innovation can be used to build communal identity, cultural continuity, and a connection to the city's roots. It describes Kawasaki Institute of Technology (KIT), a citizen-based university without boundaries, and its urban structure. It shows a diverse network of "Intelligent Plazas," of private and public places and devices, for conversation and learning with and without the help of advanced technology. And it presents a perennial web of personal and communal festivities as the city's way of growing, of keeping in touch with itself and the world.

These elements are merely different aspects of one whole: a community of communities. Its identity is made of the very strength of its cultural and scientific institutions, its physical structure, its festivals, and the role of its citizens in political life. Technology is the thread that reinforces these elements and the links between them. Kawasaki Institute of Technology, the Intelligent Plaza structure, and the network of celebrations are different ways of describing the concept of a transparent city, accessible to the hearts and minds of its citizens.

Kawasaki's new identity will derive from the purposeful transparency of its facilities and networks, from the way it subordinates high technology to the considered needs of its citizens. Instead of merely accepting the introduction of technological innovations, the citizens of Kawasaki will collaborate in planning their introduction. The city thus will exemplify the idea of Technology for People. Kawasaki will come to be known for its web of sophisticated learning resources, and for its commitment to matching technological ingenuity with intellectual, spiritual, sensory, and scientific purposes. This distinctive feature of the city -- its very identity -- will be its way of putting technology in the service of human intelligence.

Innovation: Environmental, Cultural, Technological, and Social

Since the beginning of the Industrial Revolution, there have been two opposing interpretations of technology and its role in society. The dominant school says: science-based technology is the key to progress, and automatically spells social progress; the other points to its negative outcomes, and holds that advances in science and technology are in themselves a necessary but insufficient basis for improving the conditions of life; they make for genuine progress only when they are designed to satisfy constructive social purposes.

The advanced technologies providing today's urban life impulses are production, management and financial systems, public communication, monitoring, and mass information networks. They develop according to their own dynamics and cannot guarantee social progress in themselves, but the people of Kawasaki can develop and retain cultural identity and sound social values by taking charge of these developments and their part in them.

> ... instead of focusing on how we produce and consume
> we must focus on how we conceive and perceive and how
> we communicate.1/

Information is indispensable, but in itself inert and static, useful only when combined with human intelligence, active imagination, and purpose. Similarly, the new technologies are instruments, and they may assist, reinforce, and expedite the traditional activities of learning, but they do not in any sense supplant them.

TECHNOLOGY FOR PEOPLE

Much of what we know we derive from single-source mass communication systems, be it television or the classroom. But what if we could select, receive, and produce our very own information, our own cognitive and physical environment? What if we could construct our own reality instead of taking someone else's for granted? The fusion of broad telecommunication and personal information systems opens the door to a new, optimistic outlook on the future: it can be bright and exciting, rather than gloomy and constrained. The future is not an inescapable tunnel anymore, it is an open field of opportunities.

The citizens of Kawasaki have the unusual chance of directing technology for socially supportive and fulfilling purposes. The people will be in control of their own destiny if today's opportunities are seized and put to use.

Opportunities for a New Kawasaki

- A broad concern for cultural and group identity is rising, in the wake of "internationalization" and the changes in society induced by technological advances.

- A revolutionary set of information and telecommunication technologies has arrived. It allows broad, instant, and differentiated exchange among a multitude of users. It also makes it possible to build an internationally networked, yet internally unified city by integrating its learning resources, both traditional and new, cultural and technical, public and private.

- Urban space has become expensive in Japan. It is increasingly difficult to build large new public institutions in the cities. This is an incentive to decentralize learning facilities and make them more accessible.

- New dynamics among people and industries are evolving, towards greater mobility and a search for wider horizons, in the workplace and in personal life. The phenomenon of flexible specialization in industry signals a move away from mass production to decentralized, custom-designed, and quickly responding production.

We cannot know what the future holds. But we can try to plan in a flexible manner, allowing for new interests, innovations, and unanticipated possibilities along the way. We can plan for an unpredictable future, allowing for novelty, rather than for a future we attempt to control from today's vantage point. In preparing for an open tomorrow, we propose to focus on the substance of people's cultural needs, on the continuity of society and of knowledge. We can have our feet on the ground, yet our heads in the stars.

How can we build an infrastructure for an open future of options and opportunities, yet one that conveys clarity and excitement about its prospects?

This guide's four main parts explain four main aspects of this infrastructure. They are as integrated and interrelated as the city and its communities.

Kawasaki Institute of Technology

Cities are pools of learning resources, containing an infinite amount of information. And a city is a school when its citizens can easily select that part of the vast daily information flow they wish to assimilate, to satisfy their intellectual, emotional, and social needs. A multidimensional *Intelligent City Map* of today's individual and institutional resources will be the first *KIT Catalogue*. A first KIT neighbourhood involving people, companies, and educational institutions will be tested and grow into a citywide, ever-evolving network, with national and international links.

The new technologies (such as satellites, microwave transmission, fiber-optical links, small processors combined with large data repositories, spatial organization of information) will have a profound effect on the form of learning and learning facilities. There will be a growing curriculum satisfying intellectual, spiritual, and physical needs. It will respond to spontaneous everyday inquiries, to the requirements of the highest quality of structured academic discourse, both theoretical and practical. There will be a city, nation, and worldwide tutorial system whereby students can choose their appropriate teachers, regardless of distance. And thanks to the newly evolving system of intelligent places and devices, structured learning will take place anytime and anyplace.

Today's citizens and institutions will be the first clients and owners of "Campus City," this citywide advanced learning network. It is important to heighten awareness of this new mode of education itself. This guide suggests several reflective study areas: Focusing on the innovative character of KIT will stimulate fresh impulses and the exploration of new directions and advances in the interrelated intellectual, spiritual, and sensory realms.

Intelligent Places

KIT will grow directly from today's city, its communities, companies, and institutions. Emerging organizations and ideas will require innovative environments. Their precise forms and programmes must be determined by their prospective users, yet it is possible to speculate on a proper infrastructure for these innovations, and to float some "conceptual kites," to stimulate public discussion. Proposed is a diverse network of components, ranging from the most public to the most personal.

(1) Metro Plaza: Integrating transformed train stations via an intelligent moving platform;

(2) The River Project: The Bridgehead of Kawasaki's intelligent infrastructure: 30 km of advanced city gardens;

(3) Neighbourhood Plazas: Neighbourhood-based and flexible infill spaces, highly equipped and multipurpose;

(4) Mobiles: The moving parts of Superplaza Kawasaki;

(5) Smart Boxes: The intelligent version of the *soba* shop;

(6) Information Fountains: Enlightening streetside whisperers; and

(7) Intelligent *shoji*: Domestic central nervous system, custom-designed and networked.

These elements will be rooted in the city's value system, and in its physical structure. The themes of Culture, Health, and Peace were chosen to illustrate the kinds of interest people may pursue, and which will place specific configuration demands on the plazas and devices. The first steps towards this infrastructure are closely linked to the beginnings of KIT and its citizen involvement campaign.

The City of Festivals

Festivals are part of the social glue of a community. They fuse our mental, physical, and spiritual lives. Campus City Festival is merely another aspect, a kind of other incarnation of KIT, Kawasaki's community structure, and the plazas. The beginning point is again today's infrastructure. A communal support system is proposed, for a perennial system of festivals, celebrating communities of different scale, from the individual family to the world. Kawasaki will become known as the City of

Festivals, as the host of a permanent festival of festivals. As KIT's festive *alter ego*, the festivals will explain Kawasaki to its citizens, and teach about other parts of the country and world. Three themes are presented to illustrate the kinds of new events the citizen festival committees and the KIT Festive Studies Programme may develop:

(1) A World Exposition: The city itself and its learning network will be on exhibit.

(2) The Language Festival: It will celebrate all forms of expression and communication.

(3) The Sky Festival: Honouring the sky, the air, and the heavens as the most vital, universal, and supportive human environment, and as a high-technology medium.

"24 April 1999: A Morning in the Life of Yoshiko and Kazumi" in Appendix 1 illustrates what it might be like in a young family, in this city and its festive life.

Managing Network Access and Participation

The Campus Area Network (CAN) will grow as the technological nervous system as KIT, the plaza network, and the festive structure grow. The dimensions' access and participation have many aspects: Personal, social, technical, legal. Their realization requires education and exchange, the willingness to learn and to be involved. This will involve giving people a tangible stake in the city's future, such as ownership, or the legal right to use, be it a plaza, or a piece of the riverfront. The diversified plaza system permits various forms of management and ownership.

The idea of a Public Information Utility is presented, as a way of managing CAN as a facilitating system, with the functions of management legally separated from the right to programme it.

First Step

The first step is educational: To organize a citywide collection of images and perceptions, and a canvass of cultural resources, needs, wants, and possibilities. All presently existing vocational, avocational, generational, social groups will be encouraged to submit an inventory of teachers, facilities, and subjects of interest to others; a plan for future research, growth, and development; and a list of specific technological and cultural needs, wants, and projects. These would include the self-education of the group, and its possible contribution to others. These initial meetings would be organized through the branch city halls in each of the seven wards.

Kawasaki's people can direct technology to meet their needs. They can use today's institutions to open the door to a bright future full of possibilities. This guidebook explores how the university, the festivals, and the city can be tuned to each other to help them in this undertaking. The concepts presented here are universal, and apply to many of today's cities. It is a general method of strengthening intelligence, identity, and community, not a prescription for a specific change of image. The concrete steps and devices proposed are tailored to the special character and the assets of Kawasaki City.

THIS CITY IS MY SCHOOL: KAWASAKI INSTITUTE OF TECHNOLOGY

> It is time we had uncommon schools, that we did not leave off our education when we begin to be men and women. It is time that villages were universities, and their elder inhabitants the fellows of universities.
>
> ... Why not take the best newspapers in the world at once.... Let the reports of all the learned societies in the world come to us....2/

Learning is a process of discovering distinctions, identities, and relationships. It occurs constantly and everywhere, in the family, in the street, in the shopping mall, in front of the television set. How can we select that part of the vast daily flow of information that people can assimilate -- that satisfies their intellectual, emotional, and social needs? How can we create a new kind of flexible yet structured environment of learning?

The traditional learning stages, age groups, specializations, and large centralized schools were technically convenient in the past, but they now must be reconciled with a way of life in which discovery and growth -- formal and informal kinds of learning -- never cease. The new information technologies allow low-cost and broad intelligent exchange with a variety of sources, through a myriad of channels at once, on a multitude of levels, and using largely existing space. What does that mean to our educational systems?

For one, the form learning takes can clearly change. Structured learning will take different, more complex, more fluid shapes. Today's learning institutions are based on 19th century techniques of information transfer. Building a citywide, community-based, yet internationally-minded Kawasaki Institute of Technology will be a fascinating process of experimentation, of trial and error. Here is an initial set of premises, a starter's KIT.

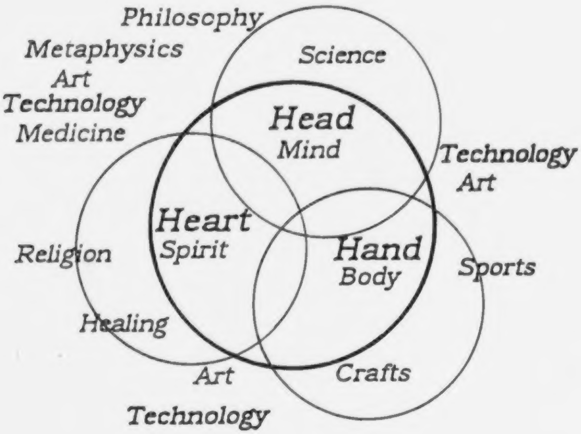
Guide to KIT

The Curriculum

We can custom tailor anybody's education to his or her needs. We will build the curriculum, spaces, and materials as the need grows. There will be continuous levels of learning. Academic credits will be given for a broad range of subjects and activities, from video programmes and digital tutorial packages to studies abroad.

Kawasaki Institute of Technology will be a university made possible through technology, rather than one exclusively focusing on it. KIT will recognize that head, hand, and heart are inextricably linked (figure 72). Primary emphasis will be on the sciences, humanistic discourse, and technology, and on mental, spiritual, and physical activities, available for all age and social groups. In addition, there will be integrated and instant public information menus, with continuous levels of structured information. They will range from basic data: city events, calendars, employment information, to highly specialized technical information services.

Figure 72. KIT Curriculum


Philosophy
Metaphysics
Art
Technology
Medicine
Science
Head
Mind
Technology
Art
Heart
Spirit
Religion
Hand
Body
Sports
Healing
Art
Crafts
Technology

Teachers and Teaching Method

KIT will not feature any single mode of instruction. When people with similar interests form learning groups, they will be encouraged to plan their curriculum and choose their teachers. If the teachers live at a distance, class meetings with two-way systems will be held.

In KIT, we will have the best teachers available anywhere in the world, to suit any student's needs. Through telecommunication links we will have a global faculty from any or all universities in the world. Our school will be truly decentralized and international.

Anyone in the city may teach somebody else something. We will have a true Citizens' College, by developing a citywide tutorial system: the old teach the young, members of one profession the other. There will be lists of qualified tutors available to work with individual students on special topics, as in the British Open University. Much emphasis will be placed on each student's own performance in writing, knowledge acquisition, composing, painting, research, science, building. Structured learning will coexist with more informal means of acquiring knowledge. There will be learning by decision making: city hall plazas will experiment with concrete forms of citizen involvement in critical decisions.

Class Hours

We will have classes in real-time and anytime, together and individually.

Classrooms

We will have open and ubiquitous schools, a citywide education concept. The family, the studio, laboratory, office, city hall, car factory, computer lab, hospital, government agencies, the streets, the *soba* shops, and coffee houses: all are our classrooms, and they are open already. Neighbourhoods can organize interactive sessions with educational video material, with their own discussion sessions after and during the programme, with neighbours teaching each other. We will also have mobile schools. Mobile teaching units will go around town, with educational programmes for children and for grown-ups, organized by any group with something to offer.

Grades

We will have individual and sophisticated methods of monitoring progress. First emphasis in evaluation will be on substantive accomplishments, not on the satisfaction of formal requirements.

Degrees

There will be a flexible range of graduation forms, from attendance certificates to advanced degrees. Students may graduate anytime, at any level of accomplishment. There will be differentiated and articulate assessments of achievements, rather than a few numerical categories.

Campus Form

The city will be the campus. There will be many levels of integration into the city. Specialized, high-level research can be more removed, and city learning and community building will be more in the centres of activity. The festivals are a campus, too.

> Sealing off campuses against a given community is an elitist medieval idea. A school should have a spiritual existence, not a poured concrete one.3/

Fundamental KIT Studies: Self-Discovery and Awareness, Making Connections

KIT will grow out of today's city, but it is important to heighten awareness of this new mode of education itself. A focus on the innovative character of KIT -- its new technologies and methods of instruction -- will stimulate understanding, fresh impulses, and the exploration of new directions. Particular areas of study will emerge, developed by community groups, universities, private institutions, and consultants, or by combinations of these. These studies may involve sociological work, art studios, laboratory experiments, and publishing.

Learning is more than a cerebral process, it involves "head, hand, and heart," which means that all advances in technical support systems must be balanced and made harmonious by progress in theoretical and scientific understanding, commitment to cultural and spiritual identity, and the sensory, physical well-being of people.

TECHNOLOGY FOR PEOPLE

Here is an illustrative mixture of study and activity areas: some more analytic and some more suggestive of action, but all interrelated.

Information and Its Transfer

What do people know? What do they want to know? How do they use information? How do new technologies evolve? How should networks evolve? How are they directed? Is citizen's privacy affected? What form does education take, what are the successful experiments? How are the roles of industry, government, and citizens changing?

Social Organization

How do individuals, groups, and institutions respond to which developments? What roles and relationships are emerging? What are the neighbourhood patterns and how are they reflected in KIT?

Network Access

How do women, men, and children participate, how do they maintain access to information? What is the role of festivals in community building? Are all the needs of all interested citizens met? What progress is being made in information technologies for blind, paralyzed, and other handicapped citizens?

Science, Art, and Culture

Is science and the popular understanding of scientific discoveries advancing? How does the cultural identity of individuals, communities, and the city evolve? How does the spiritual life and the arts respond to the new conditions? And in turn, how do new ideas about them inspire new developments? What is the content of the new infrastructures? How has the festival tradition changed, how does it continue to change? How does its meaning change? Are advanced crafts emerging? Is the tactile, sensory experience enriched?

Health

Are the citizens' opportunities for direct physical engagement increasing? Have people become more or less active since the advent of the mass media? Can contact with nature and physical activity increase? Is people's understanding of physical and nutritional balance increasing?

International Involvement

Are international links improving? Is the citizen's perception of the world changing? Is outsiders' impression of Kawasaki and Japan changing? Are business and academic links increasing? How can Japan contribute to the advancement of less developed nations? How do new planning and relief programmes perform?

Physical Structure

How is the city structure changing its physical identity? The wards, neighbourhoods, and the homes? And what new building types and urban patterns are emerging, in response to the demands made on new technologies?

First Steps: The Beginnings of KIT

An Intelligent City Map will be the first step, a comprehensive inventory of human and institutional resources available today. It will be a tool for making the city transparent, for self-discovery. It will be the first KIT catalogue. Before the Industrial Revolution the invidious distinction between the fine and the useful (or "mechanic") arts had little force, and in KIT it also will be discouraged. The traditional and the newly emerging arts and crafts, and the latest, high-technology skills (computation and other electronic pursuits), will be given equal respect. It would be tragic if, in our rush to use new technologies and acquire new skills, we allowed the long-lived traditional arts and crafts to become obsolete.

Some random examples of what the KIT catalogue will contain:

actors
apprenticeship programmes
Buddhist temples
cabinetmakers
carpenters
citizens who have studied abroad
composers
computer designers
craftswomen/men in general
dancers
engineers
fashion artists
foreign culture centres
garden designers
government offices
historians
industrial designers
information artists
jazz coffee houses
jewelers
language institutes
libraries
machinists
museums

musicians
novelists
painters
plasterers
poets
political caucuses
public hearings
public parks and playgrounds
radio and TV programmes
research labs
scholars
schools
sculptors
scientists
sho-do teachers
tea ceremony teachers
teachers of all kinds
television programmes
theaters
Zen monasteries

This map will have many dimensions. It will be interactive and constantly updated. It contains the building blocks for KIT, for the Intelligent Plaza Network, and for the Campus City Festival.

KIT is synonymous with the map, and the events, institutions, and individuals it contains. Particular student or community groups will organize it into a resource network. Professional KIT guides and educational consultants can assist. The way the resources are mapped will be determined by how individuals, groups, and organizations use them.

Existing educational institutions, both from within Kawasaki or from other parts of Japan and the world, can provide the administrative support, in an experimental way. Today's inhabitants and institutions will own KIT. New organizations will be introduced only where necessary and when opportunities arise. Companies will compensate their employees for teaching and learning activities.

The first KIT neighbourhood: As a preliminary test, a single neighbourhood will be selected for an exploration of possibilities. After making an inventory of resources and a survey of the people's educational and cultural wants, like-minded groups will be assembled to discuss ways in which their needs can be met. They would be introduced to the available spaces, teachers, and technologies. This test will involve a discovery of their own, their neighbourhood's, and their city's identity, and a relearning of what they believe learning itself to be like.

A Campus Area Network (CAN) will grow as the institutions reshape, grow, and connect. CAN is a dynamic, experimenting, changing system of advanced data storing, processing, transmitting technology. CAN will be integral to KIT, the Intelligent Plazas, and the Campus City Festival. From a basic telephone and fiber-optics-based infrastructure, CAN's hardware and communication software will evolve as need develops and requirements come into focus.

TECHNOLOGY FOR PEOPLE

The next sections will present different aspects of the advanced information city concept, but all are interconnected and will continue to describe KIT as an integral dimension of the new city infrastructure of places and festive events.

This city is a school.

INTELLIGENT PLACES

> The wheel is an extension of the foot, the book is an extension of the eye, clothing, an extension of the skin, electric circuitry, an extension of the central nervous system.4/

New educational directions, social organizations, civic ideas, and technologies have always required and brought about new physical structures. We cannot predict the precise form of new places for intelligent public discourse, nor should we try to prescribe their programme. But we can describe what their general characteristics might be, and how they could evolve. We can think of the city as a single intelligent forum: Superplaza Kawasaki. How would one structure it, what would be its first components, to set the stage for the unforseeable developments to come?

The network of individuals and institutions in our Intelligent City Map (the KIT catalogue) and the people interested in learning from them, their homes, offices, and workshops will be the first decentralized KIT campuses, the first "Intelligent Plazas." Their linkage at first will be conceptual, of mutual awareness, and later this mutual interest will be manifested as fiber-optic links, and other technological devices. Can this network be reinforced with additional "plazas," with new means of fostering learning and exchange?

All innovative environments are born out of certain traditions. Intelligent Plazas will be socially and culturally experimental, multidimensional civic institutions, but they are not entirely new inventions. We trace their lineage directly to today's and yesterday's museums, libraries, schools, research institutions, marketplaces, theaters, and community centres; and these are the very entities that should take part in their ownership, programmes, and operation. Intelligent Plazas will combine the best these institutions have to offer, and develop vastly improved opportunities for learning and networking among people.

They will be the action arenas of Campus City Festivals, new urban places with their own environments and traditions.

They are charged and shaped by the energy of their special locations and communities.

Continuity and Balance: Fundamental Values for Intelligent Places

The growth of KIT and the Campus Area Network can build cultural identity by harmonizing progress and tradition. Similarly, all technological advances will be balanced by placing equal value on advances of the "head, hand, and heart," of mind, body, and spirit.

City Mind

What is Kawasaki City? There are as many Kawasakis as there are people to experience and reflect on it. There is the Kawasaki of the mind and the Kawasaki on the map. The Kawasaki of the people, the companies, the city planners, the politicians, the immigrants, the Kawasaki of the architects. There is the city in the morning, at night, in the winter, or in the spring. The city of the past and of the future and of right now.

Kawasaki's new identity will lie in the perceptions and intelligence of its people, in the transparency of its facilities and networks, in its social goals and human values. Its identity will be the growing web of learning resources, and the commitment of matching technological ingenuity and the growth of KIT with intellectual, spiritual, sensory, and scientific endeavours, all activities of human intelligence.

An intelligent city thinks, feels, and responds, by stimulating its people to think, feel, and respond. It is not merely a place to sleep and work but a dynamic environment of environments: of conceptual and physical, spiritual and worldly, individual and collective realms. A good city is concerned about social knowledge, that is, what its citizens can know and want to know about their common reality. The structure of public information systems, the way knowledge is distributed, is essential in determining the environment of the mind, in the construction of reality itself. An expanded conceptual environment will help bring about broadened civic engagement, for an open city, clear and accessible, a city which is comfortable and vital, yet efficient and just.

There is concern about the "City Image," the way Kawasaki is "generally" perceived. How a city is perceived depends on what is known about it. It most thoroughly changes if one does not try to simply alter the surface image, but is concerned with its content, performance, and structure, visible and imagined. A city's image has much to do with feeling and intuition. How to change a city's mind?

Make the city understood. An intelligent city is articulate and comprehensible. The infrastructure of technologies and institutions should make the city transparent and intelligible to its citizens.

City Time

Who keeps the city's time? What is the rhythm? Where is its memory? Intelligent systems can keep time, set pace, and recall the city's past. But what about the city? How does it respond to time?

As buildings and places change and adjust, they can keep many of their original aspects. They can be living monuments of time: incorporating new thinking, new fashions, new opinions. Nambu, the east-west rail connection can be rebuilt as a moving platform in a brilliant, intelligent corridor. As it passes through Kawasaki it becomes its metronome. Festivals, urban customs, and city traditions rely on and set Kawasaki's time.

Urban places and buildings, the physical network linking them, and urban customs are the timekeepers of Kawasaki.

City Structure

The downtown, the Tama River edge, the port areas, various subcentres and neighbourhoods, the evolving new centres, the old village cores, and the houses in the hills are all very distinct structural elements of Kawasaki. The city derives its energy from these differences. And this energy can power the city's "network of perceptions," if the relation between its components is clarified.

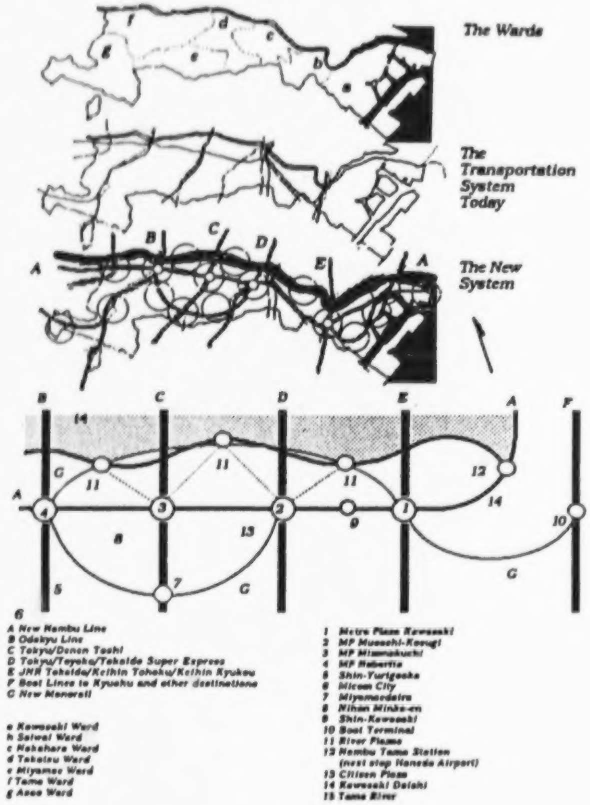
All changes to the city should heighten the characteristic differences in its structure, and establish clear relationships.

Transportation: Key to Structural Change

Hundreds of thousands of people pass through Kawasaki everyday, but most of them in a matter of minutes in and out of Tokyo. Moving parallel to Tama River is difficult. Roads are narrow and congested, and the only public east-west connection is the Nambu Line. It was built for a time with different demands.

A ladder-like network is proposed here (figure 73). Nambu Line can be extended and transformed into a high-standard and high-frequency people mover, an entirely new system, cushioned, silent, and intelligent. It will be the moving part, the internal link of a series of transformed train stations. There will be an exchange at Noborito or Inadazutsumi, where today's Nambu leaves Kawasaki today in the west, to cross the river into the outskirts of Tokyo.

Figure 73. Transportation System


The Wards
The Transportation System Today
The New System
A New Nambu Line
B Odakyu Line
C Tokyu/Denen Toshi
D Tokyu/Toyoko/Tokaido Super Express
E JNR Tokaido/Keihin Tohoku/Keihin Kyukou
F Boat Lines to Kyushu and other destinations
G New Monorail
a Kawasaki Ward
b Saiwai Ward
c Nakahara Ward
d Takatsu Ward
e Miyamae Ward
f Tama Ward
g Asao Ward
1 Metro Plaza Kawasaki
2 MP Musashi-Kosugi
3 MP Mizonokuchi
4 MP Noborito
5 Shin-Yurigaoka
6 Micom City
7 Miyamaedaira
8 Nihon Minka-en
9 Shin-Kawasaki
10 Boat Terminal
11 River Plazas
12 Nambu Tama Station (next stop Haneda Airport)
13 Citizen Plaza
14 Kawasaki Daishi
15 Tama River

Other attractions, the historic Nihon Minka-en Park for instance, or the new Citizen Plaza, will for now be reached by foot or by bus. But over time, the system will be expanded to and along the river, incorporating it into the new network and making it accessible. A southern loop will link Noborito, Miyamaedaira, and Musashi-Kosugi. These secondary links might be by light monorail, or another technology being developed right now.

The four basic devices described in this and the following section will be made possible through today's organizations, communities, and companies, not through entirely new institutions:

- a diversity of public and private information access points, the plazas, and other devices;
- a transportation system linking the major elements;
- an intelligently reclaimed river edge, pumping new air and life into the city; and
- the Campus City Festivals as link over time and space.

Castles, Gardens, Fountains: Diversity in the Plaza Network

Plazas should be malleable, both in response to local conditions and over time. They will be linked but autonomous. They will have different forms and functions, while their general architectural attributes should remain constant: specificity to place, sensitivity to people, adaptability to change, transparency, accessibility, activity, and comfort.

Here is a system of diverse model elements, ranging from the most public to the most personal information environments.

Metro Plaza, integrating transformed train stations via an intelligent moving platform: Kawasaki's intelligent castles and links to the world;

The River Project, the bridgehead of Kawasaki's intelligent infrastructure: 30 km of advanced city gardens;

Neighbourhood Plazas, a connected network of flexible infill spaces: small parks and workshops, highly equipped and multipurpose:

Mobiles: The moving parts of Superplaza Kawasaki;

Smart Boxes: The intelligent version of the *soba* shop;

Information Fountains: Enlightening streetside whisperers;

Intelligent *shoji*: Domestic central nervous systems, custom-designed, networked.

These devices and places are illustrations, conceptual kites, to stimulate public discussion.

Intelligent *shoji*

New compact and custom-designed home media environments will be marketed and leased, and existing ones expanded. They give individual households direct access to KIT study groups, the main Plaza programmes, in addition to the standard teleshopping, telebanking, and home security functions.

They can be expanded and changed in modules. Fiber-optic links will permit a level of long-distance interaction far superior to the traditional cable television systems. They will be fully integrated into the architecture. Other components may join: interactive *tatami* elements may enhance personal safety, or monitor and modify ambient space characteristics in response to mood changes or varying needs of comfort.

Initial hardware

Miniaturized, custom-designed systems containing high-resolution flat television monitors and control displays, telephone, video camera and digitizing scanner, control keyboard, personal data storage and processing facility, memory/processor units for still image storage and transmission, high-speed, high-resolution printer with imaging capability. Also available in do-it-yourself kits.

Ownership/sponsorship

The environments are leasable, or can be privately owned. Their development will be supported by public and corporate grants, and there will be an initial test network, subsidized by the city.

Information Fountains

Independent, self-contained units combine functions of the public telephone, the traffic policeman giving directions, and the streetside map and bulletin board. They will:

(1) allow personal banking and communication via telephone, keyboard, and magnetic access card;

(2) provide text and still image links to the Campus Area Network, KIT, and the Plaza programmes; and

(3) inform about the city, the Campus City system, the Festival, and art events.

Information Fountains print maps, newspapers, and personal messages. They emit short-distance radio signals, whispering news, and place-specific information into the ears of people wearing Intelligent Jewelry, miniature designer receivers. Initially, the Fountains will be based on telephone links, and exchangeable, independent video-disc systems accessed by touch and voice. Over time, the terminals will be upgraded by fiber-optic links, permitting more direct involvement in the KIT, Festival, and Plaza programmes. Ultimately, they will become cellular radio relay stations. If successful, they will emerge everywhere, integrated into the parks, the streetscape, and the buildings.

Initial hardware

Small processors driving video-disc data/image access systems. Personal communications are managed via modem and small keyboard, touch screens, and voice control. Special Fountains will have key and signal characteristics useful for handicapped citizens: the blind and paraplegic, for instance. Vandal-secure housing.

Ownership/sponsorship

The City of Kawasaki will own the system, and can license its operation and upkeep. A group of private corporations and public agencies can help in the financing, to supplement user fees.

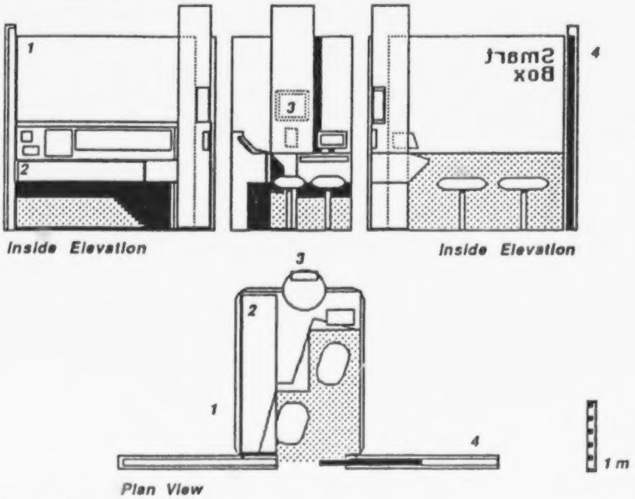
Smart Boxes

Most families will not be able to find much space and privacy for work stations and study at home. The Intelligent Plazas will become personal control stations away from home.

To make the Campus Area Network highly accessible and dispersed, there will be hundreds of fully equipped, fiber-optic-linked posts, a kind of data *soba* shop or bar, where people have an alternative to home, talk to others far away, play games, study and add to their academic credit rating while waiting for the train or bus, or engage in free investigations to relax while shopping, or during lunch break.

These Smart Boxes (figure 74) might appear in busy pedestrian areas, near important intersections and bus stops, in malls, restaurants, in combination with bars, in train stations, post offices, banks, in companies, and large housing developments.

Figure 74. Smart Boxes



Smart Box: Schematic System

1 Glass enclosure, ceiling (optional)
2 Access and study stations (see Hardware)
3 External viewing monitor and
ventilation tube (optional)
4 Variable front panel with pneumatic door (optional)

Initial hardware

Telephones; fiber-optic data/video/sound link with Plaza information and to KIT study packages and programmes; touch-sensitive access to daily bulletin and main system information; teletext/videotex access, and to private intelligent *shoji* systems; and printers. Designed for use by handicapped citizens.

Ownership/sponsorship

They can be developed with corporate support, owned by the city, and leased to malls, companies, department stores, and large housing cooperatives.

Mobiles

Media equipped buses and vans are elements of KIT and the Campus City Festival. They borrow programmes and software from any of the centres or plazas, and carry their own independent programmes.

Some will be set up as mobile production stations and beam live information and feedback into the main system. Some will be temporarily stationary units, such as experimental trucks and buses, mobile "intelligent dressing rooms," where people can try out new technologies and ideas. Others, like the Media Vans, will serve as "hit-and-run" deployment units, to support neighbourhood events, or to bring educational programmes to children and grown-ups.

During world expositions, Smart Buses can help link city attractions, the river, and plazas: these buses can be equipped with live video reception facilities and independent, daily updated electronic bulletin boards showing the events of the day and the attractions of the next stop. Buses, railroad cars, boats, and other large intelligent vehicles can serve the commuting population. They will connect Kawasaki to the infrastructure of larger Tokyo and Japan. They are dispatched as information probes, they swarm out and return, while maintaining two-way contact with the Campus Area Network. Nambu Line will be transformed into a city-internal intelligent platform.

Intelligent Jewelry may emerge as a portable plaza system. First, tiny radio receivers, then miniaturized two-way units, these elements will be designed as "wearable CommuniFashion." They will receive Campus City programmes and announcements, news, and location-specific information: visitors to Kawasaki will learn about the city, the festivals, its institutions, plaza exhibits, museums, and other attractions by what these places themselves would emit, via narrow band, short-distance transmitters.

Information Fountains would become enlightening streetside whisperers, by telling people through the airwaves about where they are, where they may want to go, what they may want to know. People themselves may programme and carry short audible messages about themselves. Long-distance personal dialogue via cellular systems will be possible as well.

Initial hardware

Microwave transceivers, cellular systems, temporary CATV and phone links, small individual processors and video-disc units, electronic billboards, flat screens, and variable-focus video projectors. Short-distance shortwave transceivers.

Ownership/sponsorship

Intelligent vehicles can be owned by the city and leased or lent to city educational events, exhibits, fairs, or to any group with a message. High-technology corporations, media companies, and transportation industries may want to sponsor the development of these vehicles and systems. Communication fashion, such as Intelligent Jewelry, will be realized in enlightened cooperation with the personal electronics market.

Neighbourhood Plazas

They will be community institutions with intensive public communication functions. They may be combined with post and other telecommunication offices, cinemas, and shopping centres. Neighbourhood plazas will be related to existing and soon-to-be-built facilities: Shin-Yurigaoka, elements of Kanagawa Science Park, Citizen Plaza, Culture Plaza, Kawasaki Daishi, ward branches of the City Hall. They would serve a specific community, and be born out of existing community service, cultural, and educational institutions. There will be two basic types, one for Kawasaki's residential areas, and one in the downtown or one of the denser ward centres, such as Shin-Yurigaoka or Miyamaedaira. These types are Intelligent Gardens and Downtown Plazas.

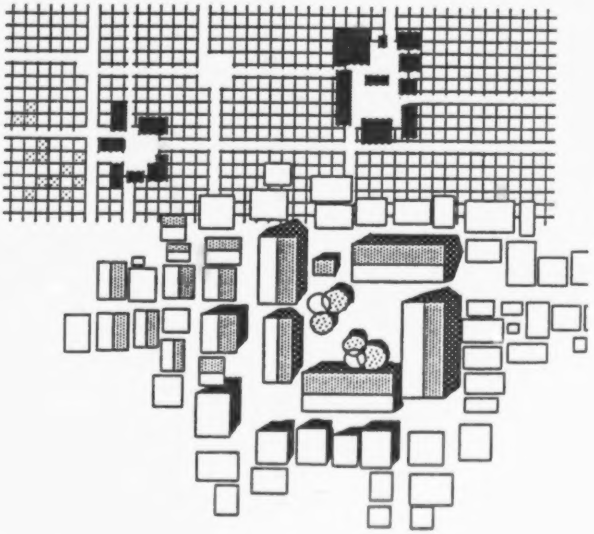
Intelligent Gardens are sculpted into the dense fabric of the residential areas (figure 75). They will be secluded neighbourhood parks, community gardens, and open spaces, surrounded by intimate workshop-like KIT access stations, community facilities, classrooms, daycare centres, health facilities, artists' studios, residences, *soba* shops, sake and coffee houses, and small restaurants. Existing buildings surrounding these new or current parks and village squares may be transformed into intelligent garden pavilions, and some new buildings and structures may be built to supplement the old.

Downtown Plazas are the urban form of Neighbourhood Plazas, in transformed existing buildings, or infill in building gaps, in downtown Kawasaki, or additions to the Citizen Plaza, the Modern Art Plaza, Shin-Yurigaoka, and to the ward branches of the City Hall. They will also be in shopping districts, vacant stores, empty lots, at secondary train stations. They will have roof gardens and meditative spaces.

Facilities and hardware

Figure 75. Intelligent Gardens

Intelligent Gardens evolve from residential neighbourhoods: as small parks, surrounded by intelligent workshops and community spaces. Existing buildings and institutions will be integrated, along with new ones.



Coffee shops, *soba* shops, bars, public news lounges, art studios, intelligent dressing rooms to try out ideas, techniques, and technologies; small workshops with KIT access, miniature video production studios. Community gardens on the ground and on the rooftops. Small local-area-network-based computers driving independent visual and alphanumeric data bases; fiber-optic and microwave links to other elements of the citywide network (the Campus Area Network).

Ownership/sponsorship

Neighbourhood Plazas would be directly based on and owned by communities of people, educational and cultural institutions, and private companies.

The River Project

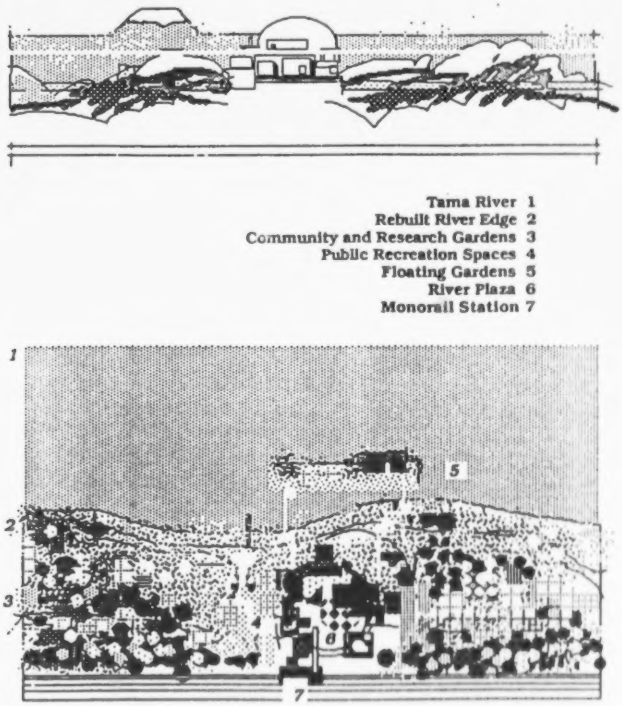
Colonies of community gardens will be distributed to KIT neighbourhoods, as part of a general river reclamation project (figure 76). This includes rebuilding the river banks, a dam and locks to keep tidal water out, and a master plan of public leisure areas, parks, community gardens, and the River Plazas. Kawasaki's citizens will gain access to new learning opportunities, and to a renewed and rooted identity. Tama River will regain its memory, and reconcile its present with its past. There will be advanced agricultural research into crops and species growing with little or no soil, or in brackish water, plants that act as filters for water contaminants, and plants that purify the air. These research activities will happen next to traditional gardens, and be carried out by private citizens and specialized research institutions, side by side. They will link Kawasaki to the world in a very real and important way: the fruits of its River Plaza research will benefit countries in all continents suffering from pollution, soil deterioration, spread of deserts, and other causes of declining agricultural yields.

The new Tama River complements the central east-west plaza system as an advanced organic structure. It will be the base of a citywide intelligent and community garden network, pumping new life into the city. Three River Plazas will be here: compact and integrated places with campus housing, agricultural and other research facilities, specialized institutions, public retreats, support facilities and anchors for river leisure, sports, and festivals. These intelligent bridgeheads will turn a new symbolic face towards Tokyo. They will be the outside connectors to the city-internal networks, linking them to this "other world" of environmental intelligence, water, fluidity, and organic growth. River Plazas will be reached by foot, bicycle, car, bus, and soon by monorail or other lightweight public transport system.

Ownership/sponsorship

The City of Kawasaki will provide the infrastructure, in a model cooperation with the City of Tokyo: the river master plan, access, community facilities, and maintenance of common areas. Neighbourhoods and individuals will own the right to use and maintain mini-farms and gardens, within certain guidelines. This right will be linked to participation in KIT, as an incentive, and in keeping with the "head, hand, and heart" principle. Research and development institutions affiliated with KIT, universities, government agencies, housing development corporations, and private user communities will support and own the plaza structures, and build facilities themselves.

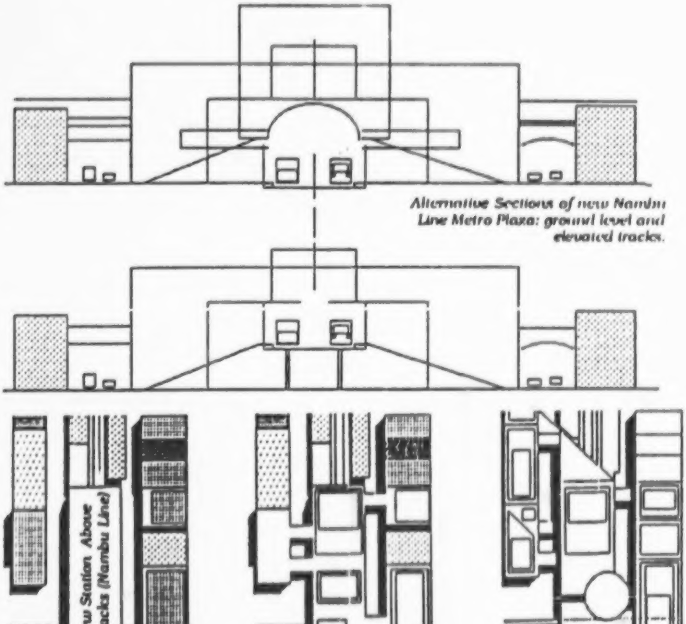
Figure 76. The River Project


Tama River 1
Rebuilt River Edge 2
Community and Research Gardens 3
Public Recreation Spaces 4
Floating Gardens 5
River Plaza 6
Monorail Station 7
1
5
2
3
4
6
7

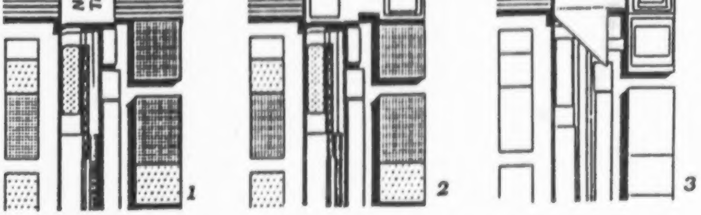
Metro Plaza

Metro Plaza (figure 77) consists of four transformed train stations and a moving platform: the extended Nambu Line, converted into a high-energy people-and-information conduit. These new intelligent "castles" are the most public elements in the hierarchy of plazas. Here, and along the Tama River, is where most world exposition events will physically happen, and where the most exposed activities of the Campus City Festival will take place (see next section). Accessibility for large numbers of people, from within the city and from around the country and the world will be critical. Metro Plaza links western Kawasaki with its east, it connects with four intercity train lines, and reaches Haneda Airport. Metro Plaza is the city's antenna and its conduit to the outside, arrival point and departure lounge. It is an international forum, and the city's permanent and malleable exposition stage. It is the world's window onto Kawasaki, and Kawasaki's window onto the world. It is the metronome that sets the city's pace.

Figure 77. Metro Plaza



Alternative Sections of new Nambu Line Metro Plaza: ground level and elevated tracks.



Illustrative plan views of a Metro Plaza in three expansion stages: (1) consolidation of station/plaza above tracks, (2) and (3) expansion of the new Plaza upward, and into adjacent buildings.

TECHNOLOGY FOR PEOPLE

Train stations are where the largest number of people congregates at any given time. They are by definition the easiest places to get to. There are usually shops, restaurants, and other community institutions directly in them, or nearby. Why not build above the tracks and transform the largest train stations into Intelligent Plazas?

The major train stations at the Nambu Line exchange points with Odakyu, Tokyu, Keihin Kyukou, and JR lines, i.e., Kawasaki, Musashi-Kosugi, Mizonokuchi, and Noborito will be transformed into Intelligent Plazas, developed in the air above the train tracks. Nambu Line will be rebuilt as a silent, cushioned system, and the new station plazas will be structurally separated from the major lines, reducing noise and vibrations. The new line will respond, inform, and facilitate external communication as people travel through the city.

KIT programmes will be produced here, and seminars and courses will be held, as well as large public events, exhibitions, and aspects of the Campus City Festival. There are comfortable small workplaces and studios available to all community and plaza members, on a sign-up or rental basis. Metro Plaza facilities will include health spaces, meditative environments, and *shakkei* gardens facing Mt. Fuji. Here, the mountain can be rediscovered and viewed. Few citizens can easily do so today.

Facilities

Shops, restaurants, tearooms, news lounges; bulletin board and event calendar gardens; teleseminar and KIT study facilities; offices; traditional private workshops, internationally networked electronic galleries; journal publication facilities for the hardcopy distribution of daily events and for on-demand printout of specific information. Roof gardens.

Initial systems/hardware

Shared satellite links, microwave communication facilities, fiber-optic CATV links, local area networks coordinating mini- and microcomputers, in turn driving video-disc-based image and text banks, CRT-based Plaza information and sign systems, public electronic bulletin boards and Intelligent City Map/KIT catalogue systems (flat screens, RGB-arrays, split-flap display boards), telex and wire service interpreters for major international and national news agencies, personal access units, such as independent touch-sensitive or voice-activated equipment.

Ownership/sponsorship

Universities and other educational institutions; corporations; public transport agencies; the city; social service, public cultural and industrial agencies; an incorporated plaza fund.

Plaza Themes

As the KIT network develops, it will, through experimentation, become clear which plaza elements will be essential and how they will be used. Structured learning, as well as free inquiries and experimenting will centre around themes, ranging from the scientific to the political. Some thematic areas will require special spaces and environments, others will not. Here are three basic examples of broad themes that will benefit from specially dedicated space and equipment, not concentrated in a single location, but as activity centres attached to several plazas throughout the city.

Art and Culture

> We must expect great innovations to transform the entire technique of the arts, thereby affecting artistic invention and perhaps even bringing about an amazing change in our very notion of art.5/

Art

This activity theme will bridge the traditional arts with art as it is affected by the new media. It would develop advanced crafts along with advanced information art: art as information and information as art. It will be a public testing ground for artists and citizens alike to stretch the limits of imagination and technology. It will explore the purpose of art as providing communal and meaningful physical and conceptual environments. It may involve people at home, via Intelligent *shoji*, be an event or performance in a Plaza or in the streets, or simultaneously involve all Information Fountains and Mobiles. It will require permanent artists studios, both traditional and experimental, in all Neighbourhood Plazas, along the river and in Metro Plaza.

Culture

What is popular art and cultural identity, and how are they changing? Participants of this affinity realm might develop and update a living museum of cultural iconography. Managed properly, it would trace through time and explain the evolution of the arts and crafts, of religious and spiritual worlds, of public images, media reality, and the collective self-perception. It will present local, regional, national, and international culture in this context. It would track traditions in times of cultural transition, and participate in their making.

Health

Balance of mind and body, harmony of nutrition, ancient and modern healing principles -- all are becoming increasingly important, especially in this time of heightened self-awareness. Control and development of one's own health rather than dependence on large centralized medical institutions is one of the benefits of increased popular knowledge, in combination with decentralizing technologies.

Here is a short list of possible plaza components and network programmes: intelligent exercise centres, interactive *shiatsu* instructions, video-disc information on traditional healing techniques, biofeedback acupuncture, biorhythm control, nutritional evaluation, interactive First Aid and cardiopulmonary resuscitation instructions; psychodynamic telecounseling, self-diagnostics, interactive visualization of healing processes, autosuggestive systems, meditation environments; psychic systems: digital astrology, I-*Ching*, and *tarot* interpretation.

Peace

A KIT Peace Studies Programme will investigate the root causes of violent conflict, research the phenomenon and history of peace, and teach nonviolent human discourse. It will become a communication centre of the global network of peace groups and nuclear-free communities. It will be a resource on war damage and peace prospects worldwide, provide channels for the transmission of grief and hope, and facilitate international exhortative teleconferencing links. Both the soft and the built architecture of this study and plaza system will reflect this: peace plaza elements would make alert, yet evoke feelings of tranquility and hope through action. There would be public expression systems, contemplative environments, and "people telephones" to the governments and communities of nuclear powers, and of countries at war. Eventually, this programme will feature a Star Peace satellite, exclusively for peace communications.

Programme and Plaza Publications: Soft and hard publications will be integral to the activity and plaza areas, including interactive video programmes and telemagazines: artKIT, CommuniCulture, healTV and PeaceNet; daily hardcopy bulletins and regular high-quality publishing programmes.

First Steps

Implementing the plaza system is entirely linked to the beginnings of KIT: an inventory of human and institutional resources, the Intelligent City Map (KIT catalogue), a citizen involvement and education campaign, and experimental test sites.

Citizen Involvement

(1) Collect images of the city, school, workplace, family life from children and old people, from all social and ethnic groups to construct a master perception of the city.

(2) Develop an educational city transformation and KIT/ Plaza planning programme. Offer credit and employer's compensation for involvement and participation. Discuss how the city works, what is important, where the goals lie, technically, politically, and economically.

(3) Translate images and discussion results into a process of physical planning, in close cooperation with city planners and private architects.

(4) Institutionalize the collective city transformation process for a period of several years, with targets and milestones.

(5) Use the Intelligent River community garden programme and involvement in the Campus City Festivals as incentive and as vehicle in this visionary transformation process.

Physical aspect

Physically, the first steps would be:

(1) the transformation of the public transport system, particularly Nambu Line;

(2) the Intelligent River Project; and

(3) the construction of temporary test plazas, in tents, modified *pachinko* parlors, as small stations in homes,

offices, laboratories, government agencies, and schools, in rented stores and buildings, and as installations in or near existing plazas: train stations, shopping malls. Culture and Citizen Plazas, museums, near Kawasaki Daishi. Temporary test plazas will host one or several selected neighbourhoods, for experiments in communal decision making, technology selection, and programme feasibility. Test neighbourhoods can be linked with overhead fiber-optic conduit.

The results of these experiments will tell us:

- what people know and wish to learn, or say;
- which technologies seem most essential, and to whom;
- how people use plazas and technologies;
- how user-communities form, and what kind;
- how the support and sponsorship structure works;
- how management and ownership might work; and
- how the permanent plazas should be programmed, structured, and designed.

THE CITY OF FESTIVALS

> ...put back the unity between the three basic parts of one's life: physical, mental, and spiritual activity.6/

Festive events are the most elegant and effective form of community participation, and of engaging "head, hand, and heart." Fairs, ceremonies, and celebrations are ways of shaping and heightening a group's identity and sense of community. They have religious and mythological roots, yet require rational planning. They are extraordinary times in shared lives.

Kawasaki City is a self-discovering community of communities: the festival as collective ritual will become more and more important, precisely as a sense of community and belonging becomes more and more conscious and cohesive. Festivals affirm the vitality of living communities, and celebrate their continuity.

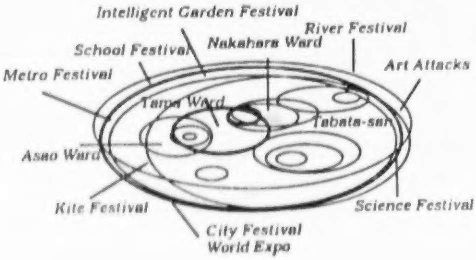
TECHNOLOGY FOR PEOPLE

New festival concepts and technologies are emerging, but it is important to be aware of the roots of festivities as cultural phenomena. Festivals and feasts are often performed to celebrate or plead for good times by a display and sharing of goods and energies with the community. It is important to understand the most ancient and profound motives and modes of having fun seriously, to nurture one's festive culture, to conceive of new, future traditions, and to understand the festive character and behaviour of other cultures.

Festivals are part of a family of these -- partially synonymous -- group phenomena: ceremonies, fetes, parties, holidays, spectacles, fiestas, celebrations, conferences, carnivals, revelries, games, tournaments, masses, rituals, feasts, parades, balls, extravaganzas, pageants, expositions, birthdays, festivities, conventions, competitions, masquerades, and rallies.

The KIT Festival Studies Programme (figure 78). According to one estimate, Japan celebrates 3,000 to 4,000 festivals each year. Kawasaki citizens may want to participate in this world of national festivals, in the festivals of its sister cities, of cities around the world in which Japanese people live, and in the most interesting festivals anywhere. The festival can be seen as a source of learning and discovery: about oneself and about other cultures. The "festive infrastructure" of Kawasaki is an important aspect of its cultural life: its festivals will be listed in its electronic Intelligent City Map.

Figure 78. Kawasaki's Internal Festival System



The KIT Festival Studies Programme will assist: it will involve anthropologists, writers, artists, community organizers, sociologists, technicians, historians, communication specialists, futurists, shamans, archaeologists, clowns, managers, magicians, entrepreneurs, priests, psychologists, you, and me.

Festival committees can invent new celebrations, and organize contributions to larger events. They can be structured around companies, neighbourhoods, or "intelligent communities" (the communities sharing certain Intelligent Network and KIT channels and programmes). Kawasaki will be known for many things, including for being the City of Festivals. Campus City Festival will be a permanent festival of festivals, a single, continuous event, with many subevents nested in it, festivals of different scales, different rhythms, and different meanings, old ones and new ones. It will be a "Time Plaza," a construct made of time, temporal architecture. The festival will be the city's way of life. Campus City Festival should be understood as a special dimension of Kawasaki, no more and no less. It should be one of its aspects, an attribute, like its river, its shape, its neighbourhoods. What might be a basic structure for Kawasaki's festive nature.

The identity of Kawasaki lies in what the city means to its inhabitants. The multitude of individual, group, and community meanings is expressed by their respective symbols and rituals. There is a myriad of such meanings, and consequently, there is -- and should be -- a very large number of ritualistic and symbolic events, ranging from personal prayers to world expositions, and from the daily to the once-in-a-lifetime occasion. The citywide KIT Festival Studies Programme will research, catalogue, and produce festivals, ranging from the smallest to the largest scale, from Tabata-san's 88th birthday to the carnival in Trinidad.

Naturally, many festival spheres will remain private, and veiled from the Campus City programme. The festival dimension of the Intelligent City Map will feature nameday parties, family anniversaries, street concerts, neighbourhood parades, ward fairs, city festivities, prefectural occasions, national holidays, sister city carnivals, famous foreign festivals, and international commemorations. The Festival Studies Institute will have a festival action group, coordinating community, company, and city events, and providing technical and money-raising support. A permanent Festival Channel will transmit celebrations from around Japan and the world to Kawasaki, and city festivals to interested cities outside. It will be one of the city's bridges to the world. A permanent Japan Festival Festival will feature the country's national holidays and its regional and seasonal festivities (for instance Kawasaki's River Festival -- *kawa-biraki*) as interpreted by Kawasaki groups and broadcast to the rest of the country. Conversely, other cities and prefectures may transmit their celebrations to Kawasaki, through KIT, at home and in the Plazas, along the river and in the streets. Here are some imaginary and real festivals that are produced in the city:

Permanent celebrations	Tama River Festival High-Tech Trade Festival
Occasional celebrations	Event Events Surprise Events
Regular celebrations	Kawasaki Sky Festival New Art Festival
Rehearsed celebrations	Company Parades Festival of Fire Engines
Spontaneous celebrations	Art Army Attacks Sudden Performances
Local celebrations	Kawasaki Daishi Festival Citizens' Festival
Global celebrations	Japan Festival Festival World Festival Festival
Tiny celebrations	Pocket Festival Street Corner Event
Annual celebrations	New Year City Birthday Party
Hourly celebrations	Festival of Chimes Chance Festival
Silly celebrations	World's Shortest Festival Festival of Portable Radios
Serious celebrations	Religious Festivals Cease Fire Festivals
Personal celebrations	Tabata-san's Street Festival My Graduation Party
Transitional celebrations	Rites of Passage Festival of Changes

Three Campus City Festivals

Kawasaki World Exposition

Today in our cities, most learning occurs outside the classroom.7/

This permanent -- yet periodically climaxing -- event will exhibit the city itself. It will present Kawasaki as a transparent entity of many complex layers, with learning and knowledge sources everywhere and at all levels. Advanced intelligent and graphic technology can unfold the city and display it as a breathtaking collective artifact, as an ubiquitous exhibition pavilion.

It will show the city to its citizens, and its citizens and the city to the world and any visitor. It will be a mirror, a window, and a magnifying glass. Any given cubic meter of Kawasaki contains an infinite amount of information. It only has to be detected and pointed out. Some exposition themes:

the Kawasaki of the children
daily movements
flowering trees
ward economies
Shinto shrines
oral histories of steel workers
formal learning resources
calligraphers
birthdays per hour

Once a year, there will be its climax, the This City Is My School Festival, a festival of scale, a celebration of identities, of a thousand ways of learning. This festival will reveal the city to itself, to exposition visitors, and to places far away. This week-long event will have, as an example, different scales of groups celebrate themselves: Monday might be a day for individual happenings, birthdays, *karaoke*, and so on. Tuesday may be a day for neighbourhood fairs and parades. Wednesday may be Ward Pride day, Thursday could be the Tama Advanced Agriculture Contest, Friday Open House Day for all high-technology companies, Saturday party day for public transportation, and Sunday a climactic orchestra of citywide celebrations, spontaneous as well as meticulously organized.

The Language Festival

> language - ...any means of expressing or communicating, as gestures, signs, animal sounds, etc.8/

Babylon may have been an ill-famed city, but its sounds must have been fun: the mere joy of a multitude of tongues, of national and regional idioms and dialects. Exchange, contact, misunderstanding, embarrassment, challenge. How many languages do you speak? What languages do you dream in? How many dialects are there in Japan? How many *kanji* signs? How many meanings to each *kanji*? Interested in Arabic, Sanskrit, Cyrillic, Runic writing? How much German is there in Japanese? How much Chinese in Hindi? How many people in Kawasaki speak which foreign languages? How many communicate with their computers in Braille?

How is our language changing with technology? What language does your computer speak? What writing system do you use? Is body language international?

Participating technology: visual languages, woman/man-machine language interface, translation systems, dictionaries, spelling checkers, script systems.

The Sky Festival

Many festivals in Japan deal with the sky, air, and the heavens. These festive artifacts are witnesses: flags, banners, kites, balloons, sound, smell, light, fire, steam, and smoke. But the sky is also the space in-between a supranational dimension, it is the largest visible object, and yet it cannot be owned. Sky is the most taken-for-granted environment, and yet everyone breathes it. Sky is also a high-technology medium: thousands of people travel through it at any given moment, and it is crammed with man-made information: light beams, sound waves, electromagnetic waves, X-rays, and pollution. And it is brimfull with cosmic data we have not even begun to decode. Sky is life. When you think about it, it fuses head, hand, and heart.

> An important task for artists and artist-planners is to find elemental, sculptural, and ecologically responsive means of neutralizing pollution, especially in industrial areas, and of transforming what was threat into something useful, or ideally, delightful.9/

First Festival Steps

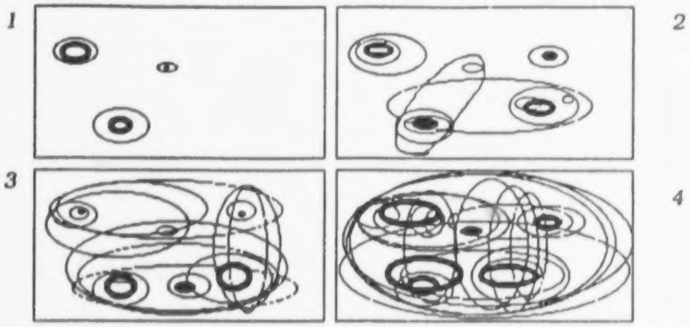
No special strategy is required. Any step is a step in the right direction.

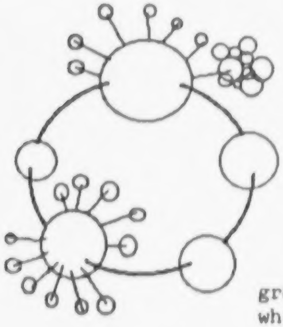
MANAGING NETWORK ACCESS AND PARTICIPATION

No passengers on the spaceship Earth. Everybody's crew.

Public access to information will be publicly organized. The mechanism is clear: Intelligent Plazas (figure 79) are the access points to Kawasaki Institute of Technology and to a host of other individual and organized information sources. Public and home access relies on the Campus Area Network (figure 80) as the general medium of communication, an integrated and evolving system of data banks, various input and access stations, coaxial cable, fiber-optic and telephone carriers, microwave, satellites.... But what will guarantee active access?

Figure 79. Intelligent Plazas



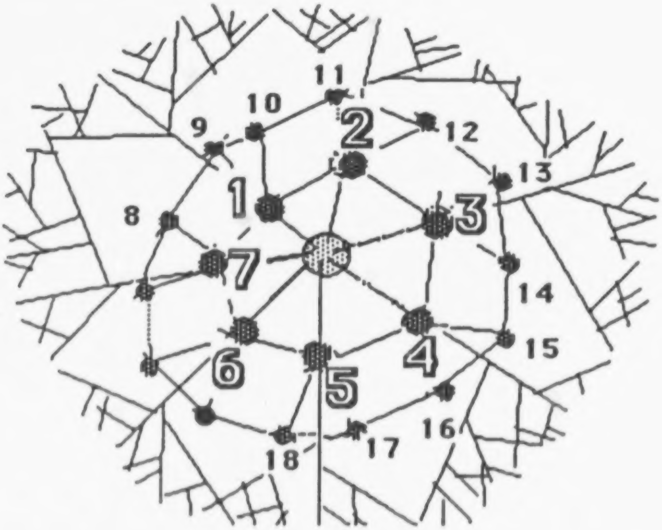


The system of plaza communities grows from first test neighbourhoods to independent yet linked networks.

Diagram of a community of communities. As information communities grow, they may form subgroups which found their own plazas.

The evolving citywide intelligent network, that is, the citizens, KIT, the Plazas, or the Festivals, will really consist of a series of disaggregated, nested networks, structured around communities of users. Many of such communities already exist, in neighbourhood centres, citizen plazas, adult education programmes, public libraries. All citizens will be the clients, their own clients, for an experimental education system, accessible at home, in the streets, libraries, malls, new plazas, and

Figure 80. Campus Area Network



The growing network of Metro and River Plazas (1-7), Neighbourhood Plazas (8-18), Smart Boxes, Information Fountains, and Living Room Plazas (Intelligent *shoji*). The central element and the links represent CAN, coordinating the Plazas and managing interaction with their programmes.

festivals, open to all and everyone. Over time, both Intelligent Plazas and special festive traditions will become the focal points of these user-communities, at every scale.

The individual plaza as a social and technical organization will grow directly out of a client community. Access to information and communication technologies is therefore built in. Every user of the intelligent network would be a member and client of a Neighbourhood Plaza, which would manage access, for a fee, or in exchange for services or labour.

There will be two basic kinds of exchanged information: the one shared between users on an informal basis, such as mail or bulletin boards, and programmes produced for structured use, whether by and for individuals or incorporated entities. Programmes can be channelled through the plazas as communication communities. Interpersonal exchange can be networked freely among groups, very much like the telephone system.

The diverse system of public and private stations, intelligent gardens, information fountains, mobiles, and festivals provides the opportunity to manage different components differently. In the Neighbourhood Plazas, an elected KIT Clearinghouse will coordinate elected Plaza committees. The committees and the Clearinghouse will manage activities, participate in KIT plaza research, and monitor developing demand for new media services and products. They will nurture a publicly-oriented media industry and provide public education and technical assistance for media use and information access. It will be accountable to the public.

Every user would own a share in the plaza, and so would contributing corporations, very much like shareholding club memberships. Every shareholder would have equal voting power regardless of the size of the contribution. If one thinks of Kawasaki as one big intelligent plaza, then everyone becomes a voting shareholder in "Kawasaki, Inc." Similarly, there will be intelligent plaza elements in all ward branches of the city government, with a clearly defined agenda of active engagement in important planning and policy decisions affecting the public. The network of Plazas will mature like a living organism: as the system grows stronger, user- and Plaza-communities will divide and form client groups for new Plazas.

The Metro Plaza system will have strong neighbourhood components, but also be designed and managed as conduit to the rest of the nation and the world. Consequently, they will be owned by public foundations composed of government bodies, educational institutions, and corporations, and staffed with the best personnel from around the world.

The Smart Boxes, Information Fountains, and Mobiles will be owned and maintained by the City of Kawasaki. Boxes and Fountains would yield user-fees, and the mobile elements could be rented or leased to educational institutions, special interest groups, community groups, or anyone who wants to stage an informative neighbourhood event.

A combination of taxes, grants, commercial licensing fees, service sales, pay-per-use rates, and subscriptions can provide the financial support for the Intelligent Network and Plaza system. Specific elements, such as commercial programmes, educational packages, or the basic carrying media themselves, such as fiber-optic cable and microwave transmission services, can be provided privately, if free public programming access is guaranteed.

TECHNOLOGY FOR PEOPLE

A Public Information Utility

Citizen-to-citizen communication outside structured plaza programmes, and exchanges between plazas and with other cities might be managed by a common carrier service: a Public Information Utility, in effect managing the technical side of the Campus Area Network.

This Public Information Utility will have no authority over and no responsibility for the content and direction of information exchanged. It will simply manage equal access to the media, and look to the KIT Clearinghouse for stimulation of technological innovation, as directed by the experiences gathered. It will therefore help foster a service and supply industry specializing in decentralized public communication and education needs.

This network utility will be operated as a public and exclusive entity providing information throughput, storage, and processing services on a strictly technical basis. Its function will be legally separated from the right to programme it, very much in analogy to the telephone system. It will not be a centralized control entity but a mere technical support and access service, providing coordinating linkage between networking communities, plazas, external groups, and sources.

As for what information can be demanded, received, produced, and distributed -- there are several ways to catalogue programming. As an example of a simple method, the Information Utility will structure the hundreds of channels available through fiberoptic, microwave, and satellite technologies into subject matters or categories, in a tree-like fashion. All channels will be fully accessible to public search and retrieval, on a subscription or user-fee basis, payable to the plazas, which in turn will reimburse the Utility. Everyone, citizens, government agencies, and private corporations alike, will have the right to produce contributions, structured by the Utility, and offered in their respective categories. These "programmes" will range from bulletin board messages to full university courses, to entertainment.

First Steps to Participation

Powerful information systems alone do not make a city more involving, intelligible, or identifiable, but the discussions stimulated by their potential will. The first task, then, is educational -- to organize citywide exchanges, discussions of all kinds and among all groups. These citywide discussions will be part of the initial KIT programme.

One can begin with a collection of images of the city, school, family life, from children and old people, from all social and ethnic groups, to construct a master perception of the city. Then, a citywide canvass of cultural resources, needs, wants, and possibilities will be organized. All presently existing vocational, avocational, generational, social groups will be encouraged to submit an inventory of teachers, facilities, subjects of interest to others; a plan for future research, growth, and development; and a list of specific technological and cultural needs, wants, and projects. These may include the self-education of the group, and its possible contribution to the education of, or performances for, others. These initial meetings can be organized through the branch city halls in each of the seven wards. Each ward will be linked to the citywide KIT Clearinghouse, and all local inventories of resources and proposals will be accessible via the Clearinghouse's data bank.

The first KIT test neighbourhood described in the previous sections will be involved in a process of discovering the city's identity and its potential as a rich source of learning. Their findings will be publicized and reinforced throughout the city.

Elementary school education, too, can become more integrated into time and place, allowing children and adults to be more aware of and active in their social and urban environment, yet satisfying all traditional educational requirements. This is where the future begins.

Outline for a New Elementary Education Programme

1. Preliminary experiences and introductory activities

   Child's self-awareness
   Perception of shapes
   Perception of the immediate environment
   Investigation of "good" and "bad" environments
   Evaluating and deciding

2. The individual and his/her relationship to object, time, and structure
   The object as a structure
   The object in relation to other objects
   The object transformed through a change of identity
   The individual and his/her relationship to objects in space
   The individual and his/her relationship to time and transformation
   The individual and his/her relationship to structure

3. The individual and his/her relationship to an organization

   The classroom and participants as an organization
   The classroom and participants as an organization transformed
   The organization of the natural environment
   Its transformation by 'natural' and 'human' forces
   Community as an organization transformed by natural and social forces

4. The relationship between the individual, the community, and the environment

   The community as an environment
   Spiritual life and the community
   Private property and the community
   Change and the community
   Government and the community
   The individual and his/her environment
   The individual, the community, and the environment

Summary of Participation Concepts

Take the initiative for "head, hand, and heart"

> Remember: rather than technology itself, the free and unrestricted access to its inherent power will help decide whether the people of Kawasaki City will be actively involved or manipulated, of strong and diverse identity or culturally homogeneous, alive, and forward-looking or controlled and stifled. Seek to satisfy the intellectual, spiritual, and physical dimension of human intelligence.

Build community structures

> Make space for people to get together and "incubate" ideas about KIT and their neighbourhood, to "conspire" and to simultaneously learn and teach. Foster festival structures for people to get together and to understand themselves and the rest of the world.

Make the city intelligible

> Make it accessible through transparent systems and enlightening actions: the transportation network, the river opening, the plazas, and the festivals as community mirrors.

Give ownership to organizations and spaces

This is the core element of the principle that everyone is an owner of "Kawasaki, Inc."

Give incentives for civic engagement

Strengthen communities around plazas, programmes, and festivals, by having plazas, programmes, and festivals evolve directly out of communities. Initiate a programme whereby corporations compensate their employees for engagement in civic activities, that is, for civic development work for "Kawasaki, Inc." Distribute the right to use and farm a part of the Tama River advanced agriculture project, in return for participating in KIT.

Provide analysis and feedback on citizen control of information

Everyone needs to learn what is being learned about how participation works.

Make investors, researchers, and developers accountable

Involve them in the community building process. Regularly discuss and publish their plans and findings in plain language, through the network, in hard copy, and in conferences.

Open up city and ward planning methods

Educate, nurture, and query "citizen experts."

NOTES

* This is the final proposal of the contestant to the International Concept Design Competition for an Advanced Information City, Kawasaki City, Japan, 1987, cosponsored by Japan Association for Planning Administration and Mainichi Newspapers. It was prepared by Peter Droege, with Leo Marx, Julie Moir Messervy, Lisa Redfield Peattie, Otto Piene, William L. Porter, and Winifred Richmond.

1/ Gene Youngblood, "The Mass Media and the Future of Desire," *CoEvolution Quarterly* (1977/78).

2/ Henry Thoreau, "Reading" in Walden (New York: Penguin, c1854, 1985 printing).

3/ Otto Piene, *More Sky* (Cambridge, MA: MIT Press, 1970).

4/ Marshall McLuhan, "Classroom without Walls" in *Explorations in Communication* (1960); *The Medium is the Message* (1967); "Flip Points" (Jerry Brown Meets Marshall McLuhan), *CoEvolution Quarterly* (1977/78).

5/ Paul Valery, "The Conquest of Ubiquity (Aesthetics)" (originally published in 1931) in Walter Benjamin, *The Work of Art in the Age of Mechanical Reproduction* (Illuminations) (1936).

6/ *Journal of a Pupil: Teachings of Gurdjieff* (London: Routledge and Kegan Paul, 1961).

7/ McLuhan, "Classroom without Walls."

8/ *Webster's Deluxe Unabridged Dictionary* (New York: Simon and Schuster, 1979).

9/ Piene, *More Sky*.

ADDITIONAL REFERENCES

Abrahams, Roger D., "The Language of Festivals" in Victor Turner, *Celebration* (Smithsonian Institution Press, 1982).

Berger, Peter L. and Luckmann, Thomas, *The Social Construction of Reality* (Garden City, NY: Doubleday, 1966).

Blakemore, Frances, *Japanese Design Through Textile Patterns* (Tokyo: Weatherhill, 1984).

Engel, Heino, *Measure and Construction of the Japanese House* (Tokyo: Charles E. Tuttle, 1985).

Lynch, Kevin, *A Theory of Good City Form* (Cambridge, MA: MIT Press, 1981).

Marx, Leo, "Does Improved Technology Mean Progress," *MIT Technology Review* 1 (1987).

Nakane, Chie, *Japanese Society* (Berkeley: University of California Press, 1970).

National Braille Press, *Add-Ons: The Ultimate Guide to Peripherals for the Blind Computer User* (1986).

Nelson, Doreen, *City Building Educational Program* (CBEP Manual) (1975).

Sakurai, Tokutaro, "Japanese Festivals," *International Society for Educational Information Bulletin* 25 (1970).

Wurman, Richard Saul, *Making the City Observable* (Minneapolis: Walker Art Center, 1971); and *Yellow Pages of Learning Resources* (Cambridge, MA: MIT Press, 1972).

APPENDIX 1. 24 APRIL 1999: A MORNING IN THE LIFE OF YOSHIKO AND KAZUMI

The sun came across the horizon like a peach. Nobody noticed it in their little house in Nakahara ward. It was very quiet, and all they could feel was the distant rumbling of the Tokaido Super Express. Yoshiko rolled over and whispered: "It's your turn to take the kids today. It's about time I spent some time with my sister in Yokohama. Plus I've got to put in some hours at the *shoji* and I need some peace and quiet."

There was an approving grunt from Kazumi's direction. It was Sunday. He didn't mind. In fact, he couldn't wait to meet his buddies at Miyamaedaira Plaza for some scheming: They wanted to start their first international venture. God knows what might happen. Everyone had been acting pretty excited lately. "Right," he mumbled, "fair enough. We head for the plazas. Maybe the river. I'd love a day off."

The children were already glued to the flat screens of the intelligent *shoji*, their ears plugged. An Italian children's programme was on, an old-time interactive game but still fun to play with. You could actually go wild with some kids from Rome and New York at the same time, some three-city game of tag. A mind game of good guys and bad guys. It was silly, but Jun and Hidemi were mostly excited about the fact that it was evening in the United States and the middle of the night in Italy. Didn't their parents mind at all?

Kazumi chased them into the bathroom, while Yoshiko was busy with breakfast. "How's the ward festival coming?" Kazumi asked her through the steam of the *miso* soup, "me and my friends at KIT are going crazy over next month's events. The people at the pneumatics lab will float giant helium gardens, for better viewing of Mt. Fuji from Kawasaki Eki Plaza. Everyone's outdoing one another. My friends use the festivals to launch our Global Chip venture. You know, we'll teach microchip design wherever they want us. It'll be a circus."

Yoshiko had been chosen to be this year's manager of Nakahara Ward Pride Day: "You and your crazy ideas. I'm glad our ward is a little more down-to-earth. There will be twelve school parades and an Intelligent Open House at all the tutors' houses, and workshops. Oh yes, believe it or not, we've got some satellite time, too. The Korean Women will make a presentation in Seoul Lions Club. They found a way to get some money from Korean companies, for an educational fund for older women of all nationalities."

The kids were busy cornering the cat in the bedroom. Both were enlisted in their school parades. They had been given the assignment to design and wear their own school uniforms. Hidemi had already progressed quite a bit; she was convinced everyone should look like an azalea, the city symbol flower. For weeks she had collected azalea-like materials. And Jun was determined to wear what he called his Global Uniform. He was quite the conceptual type. His class had done some research on school uniforms, from the old Egyptians to the Prussians, to today, British, Swiss, Chinese, Moroccan, and so forth. He wanted to wear a piece from every uniform he could copy somehow. (Hidemi thought his idea was bound to fail, for being overly conceptual. She knew he would wind up borrowing from her precious azalea stock.)

...to be continued

SYNTHESIS OF RESEARCH FINDINGS

HOPEFUL BEGINNINGS: A STUDY OF INFORMATION SYSTEMS IMPLEMENTATION IN DEVELOPING COUNTRIES

J. S. Edralin

INTRODUCTION

In the course of conducting the Research Project on Information Systems for Local/Regional Development, the United Nations Centre for Regional Development (UNCRD) has collected information on the state of the art of information systems relevant to urban and regional planning, the training needs in the uses and applications of such systems in developing countries, and the development and implementation experiences of specific information systems projects. The research project findings indicate that computer-based information systems are being introduced in local/regional planning offices which are beginning to play an important role in improving the planning process. The emergence of information systems projects is therefore one of the more hopeful developments in local/regional planning in developing countries.

Phase I of the research project identified two concrete factors which appear to influence the development of information systems for planning in four Asian countries (Malaysia, Philippines, Republic of Korea, and Thailand). These factors are: (a) awareness and understanding on the part of policymakers, planning administrators, project managers, development planners, and other staff, of the value, use, and application of information systems; and (b) adequate resources (e.g., funds for adoption of information technology, and information or communication infrastructure), relevant, timely, and reliable data for planning, and technological know-how. In an earlier volume entitled *Information Systems for Urban and Regional Planning: Asian and Pacific Perspectives*, we have presented the reports of the four Asian case studies; hence we will not deal with them here.

Phase II of the research project underlined the need to assist developing countries to upgrade the effectiveness of personnel responsible for developing and implementing information systems through the provision of appropriate and relevant training programmes. It attempted to determine the right training approach via the consideration of training needs, target group, the type of training currently undertaken, the training methodology, and the problems in information systems training in selected South Asian countries (India, Nepal, Pakistan, and Sri Lanka). The research results were reported in *Regional Development Dialogue*, vol. 8, no. 1, Spring 1987.

Phase III of the research project examined the strategies used by planning offices as they struggled to develop and implement their information systems projects. The three country case studies (China, Indonesia, and Thailand) offered on the preceding pages of this volume tell the story of the information systems projects, looking at their achievements, their problems and constraints, and their prospects for the future.

This brief study provides an overview of the information systems implementation experiences as documented in the following cases: "Information Systems Project for Urban and Regional Planning in China," by Yu Hong; "Remote Sensing System and Digital Processing for Regional Planning and Urban Monitoring in Indonesia," by Suroso Moersidi; and "Information Systems Project for Urban Planning at the Bangkok Metropolitan Administration," by Arporn Chanchareonsook.

CONCEPTUAL FRAMEWORK FOR EVALUATING INFORMATION SYSTEMS IMPLEMENTATION

International agencies and other organizations, such as the United Nations, the World Bank, the United Nations Development Programme (UNDP), the United Nations Industrial Development Organization (UNIDO), the U.S. Agency for International Development (US/AID), the Overseas Development Administration (ODA), the Organisation for Economic Co-operation and Development (OECD), the Urban Institute, and the International City Management Association (ICMA), have their own procedures for evaluating projects.1/ In most cases, however, the emphasis of evaluation is on work load, performance, effectiveness, and efficiency measures.

For instance, the performance measures used by the OECD in evaluating the performance of government computer systems are:2/ (a) justification of the application (i.e., meeting users' needs, avoiding duplication, and impact on social objectives); (b) personnel (i.e., qualifications of the computer staff, stability of the computer staff, and qualifications of maintenance personnel); (c) procurement (i.e., technical criteria for the hardware and software; geographical criteria which include availability of maintenance personnel within a certain area, availability of replacement parts, and availability of a back-up; economic criteria which include implementation and operating costs; an application and cost-performance ratio of the computer system; and political criteria which are concerned with the general economic policy of the country); and (d) the management of computer activities (i.e., the flexibility of application software, the level of use of manpower, the level of utilization of equipment, and the availability of operating personnel).

The ICMA identified a list of measures of service effectiveness, i.e., service quality of selected municipal services, and provided suggestions as to the data collection procedures needed to gather those data. To evaluate library services, the following measures are used: (a) overall citizen satisfaction; (b) comprehensiveness/timeliness; (c) reliability/availability; (d) physical attractiveness; and (e) accessibility.3/ To measure the effectiveness of handling citizen requests for services and information, the following measures are used: (a) satisfactory response to, and fulfillment of, requests for services and information; (b) speedy disposition of requests for services and information; (c) quality treatment of persons requesting service or information; and (d) convenient and effective intake of citizen requests.4/ According to the ICMA, the implementation of these effectiveness measures requires institutional support (i.e., interest of top management and presence of a centrally located person to keep implementation efforts moving; availability of staff and funds for measurement and analysis; and operating agency interest and participation).5/

While the performance and effectiveness measures are useful in evaluating projects, there is increasing recognition that the measures are difficult to apply. Likewise, it is difficult to measure the success and failure of projects.

Ingram and Mann observe that:

> Success and failure are slippery concepts, often highly subjective and reflective of an individual's goals, perception of need, and perhaps even psychological disposition toward life .... Especially before a policy is implemented, policy success or failure is in the eyes of the beholder.6/

According to Ingram and Mann, the principal obstacles to the use of success and failure measures are:7/ (a) The problem of choosing an objective measure of success acceptable to all conflicting value positions; (b) The problem of evaluating policy that may be a hesitant first step in the direction of a much broader programme, but in itself seems inadequate; (c) One is faced with significant "what if" questions that cannot easily be answered, except by rhetoric of interested parties; (d) The time frame and environment conditions within which policy is evaluated may also alter the judgement about success and failure; (e) The relationship of one policy to another may further complicate the judgement about policy success and failure; and (f) Boundaries create powerful psychological attachments that condition the terms, process, and approach to policymaking.

Therefore, the question is raised: Does one evaluate policy success or failure as though no such institutional barriers exist, or does one accept those institutional barriers as legitimate and then proceed to evaluate policy within that context?

It is also argued that:

> Evaluating many of the activities for which a local planning department is responsible is a soft science. Some activities like networking do not translate into quantifiable performance measures. Although the number of telephone calls placed and received and the number of meetings attended can be measured, the qualitative importance of spending time in these ways is the value of the information obtained and shared rather than the number of calls or meetings. The number of products produced by the planning department is another measure of its productivity that does not necessarily reflect quality of staff performance. 8/

In an examination of communication technology projects in developing nations, Emile G. McAnany found that several internal and external factors are most likely to affect project success:9/ (a) criteria for successes are based on an implicit or explicit set of values; (b) judgement has been too restricted to internal efficiency standards; (c) contextual factors have largely been ignored; (d) equity as a criterion for success imposes its own criteria; and (e) a mix of contextual and planning factors is required.

The research project avoided ascribing success or failure to the information systems projects but instead tried to identify the factors within each project that helped or hampered the achievement of its objectives. The self-evaluation or case study approach was used to examine and analyse the problems of the information systems projects.10/ Each case study, prepared by planning or project directors, examined: (a) how well and how effectively the project was performed; (b) the factors that seemed to contribute to or inhibit the achievement of the project's objectives; and (c) how the project could have been improved.

HOPEFUL BEGINNINGS

IMPLEMENTATION EXPERIENCES OF INFORMATION SYSTEMS PROJECTS

Institutional Support

Several information systems projects are now underway in the cities of China, Indonesia, and Thailand. China has recently started four urban information systems projects: the Urban Construction and Management Data Base System, the Urban Traffic Information System, the Urban Planning and Management System of Huhehot City; and the Urban and Rural Construction Information Retrieval System (URCIRS). The Urban Construction and Management Data Base System was set up by the Beijing Urban Planning Administration in 1986. The Urban Traffic Information System was initiated by the China Academy of Planning and Design. The Urban Planning and Management System of Huhehot City was created by the Huhehot Urban Planning Administration of the Inner Mongolia Autonomous Region. The Urban and Rural Construction Information Retrieval System was built on the experience of two bibliographic journals. URCIRS was developed in 1986 by the China Building Technology Development Centre.

The Indonesian Remote Sensing System and Digital Processing Project, launched in 1980, was a joint venture of the Government of Indonesia and the Government of Japan.

In Thailand, the Land Information Systems Pilot Project was initiated by the Bangkok Metropolitan Administration (BMA). The BMA secured the assistance of the Canadian Northwest-Stewart Weir Group and the Australian Q. A. C. S. Overseas Projects PTY Ltd.

A characteristic feature of these information systems projects is the inclusion of government commitment and support, funds, and external technical assistance for project development and sustainability.

Services Provided by the Information Systems Projects

The Chinese Urban and Rural Construction Information Retrieval System has a primary objective of carrying out information retrieval and computerized compilation of the Chinese-language bibliographic and abstracting journals. It is designed to provide retrospective retrieval and selective dissemination of information (SDI) services, promote the establishment of a distributed information retrieval network, and facilitate nationwide on-line search through its bibliographic data base.

The services provided by the Indonesian Remote Sensing System and Digital Processing Project consist of: pre-processing of data (e.g., colour composite image, geometric correction, trimming, and sampling band); graphic information (e.g., analogue to digital conversion of thematic data on soil depth, soil types, rainfall, geology, slope, and elevation); thematic maps (e.g., land cover, geological, drainage pattern, soil moisture content, and soil colour maps); and land evaluation map through the use of land evaluation and analysis models. The project has conducted two pilot studies which demonstrated the use of the information system in physical planning and monitoring: the agricultural land capability evaluation study in Java and Madura islands; and the evaluation of land-use change in metropolitan Jakarta and the surrounding areas.

The Bangkok Metropolitan Administration's two experimental computerized land information systems projects seek to provide information support for its mapping projects. The Canadian team's pilot project has demonstrated the application of land information systems in an inner district area in Bangkok. The system contains six thematic data bases (planning, water services, telephones, electricity, sewerage, and cadastres). The Australian team's pilot project has demonstrated in another area, the use of timely and accurate orthophoto maps in flood control planning, public works planning and design, tax collection, and utilities and public administration. In addition, in 1986 the BMA has initiated a land titling project, with the assistance of the World Bank and the Asian Development Bank. The goal of the project is to produce urban maps and aerial photographs with derived cadastral overlays.

Achievements of the Information Systems Projects

Information systems are employed by the planning offices in the three countries for various uses. The Chinese Urban and Rural Construction Information Retrieval System is not yet fully operational; however, it has identified a specific benefit with provision of information to users both in China and abroad. It plans to market its end product to foreign users in different required languages.

Indonesia's remote sensing project produces information that can be used in the physical planning and monitoring activities of various government departments, specifically in the: (a) evaluation of agricultural infrastructure planning undertaken by the Directorate General of Water Resources and by the Directorate General of Housing, Urban and Regional Planning; (b) evaluation of critical land, forest zoning, and estimation of forest volume undertaken by the Ministry of Forestry; (c) estimation of flooded area undertaken by the Directorate General of Water Resources; and (d) monitoring of changes in land cover undertaken by the

Directorate General of Water Resources, the Directorate General of Housing, Urban and Regional Planning, and the Ministry of Forestry.

The Bangkok Metropolitan Administration has taken the first steps to introduce a computerized land information system. The next task is to adapt it to the requirements of urban planning in metropolitan Bangkok.

Problem Manifestation in Project Implementation

The information systems projects in the three countries hold promise for alleviating some of the problems they have faced in the initial implementation stage. The projects spent the initial project year in establishing and pilot testing the information systems.

The Chinese Urban and Rural Construction Information Retrieval System noted problems with the limited data base, system capability, and the lack of funds for hardware acquisition.

The Indonesian remote sensing project faces the need to integrate the data held by local and national agencies involved in urban and regional planning. Data integration in the Indonesian context requires the incorporation of socioeconomic and natural resources data. It also requires cooperation among the various planning agencies. In seeking to become a geographic information resource centre, the remote sensing project needs to evolve patterns of working which enable its information resources to be effectively disseminated and used by all the planning agencies.

Training aimed at improving technological skills is one of the critical needs of the computerized land information system of the Bangkok Metropolitan Administration. The technical manpower base of the project has to be greatly strengthened. The personnel must not only be adept in the new technology; they must also acquire a background of relevant knowledge to enable them to evaluate the various mapping project proposals.

LEARNING FROM THE CASE STUDIES

In their initial implementation stages, the three information systems projects have had a fair degree of success in achieving their objectives. Whether the projects can be moved out of the experimental stage will depend on whether the necessary institutional and organizational support can be developed or strengthened. This requires adjusting the projects' organizational structures to make optimum use of their human and material resources -- by stimulating awareness in and replication of the projects, attracting and sustaining the participation or involvement of planners and other users, disseminating the products of the information systems, supporting creation or development of technical skills, and providing pre-service and in-service training. This also requires addressing the needs of policymakers, decision makers, and planners -- by providing reliable, timely, and relevant information for decision making. The products of the information systems must be useful to planners to improve the planning process.

The maintenance and sustainability of the information systems projects would not be without problems. They would be costly. They would require top-level commitment and support, interorganizational coordination, and technical expertise. As government projects, they would be susceptible to their own bureaucratization.

Thus, the information systems projects are confronted with the challenging task of responding to organizational and training needs. The most important of these needs are: (a) to seek innovative ways to provide, deliver, and advertise their services; (b) to achieve a maximum cost-benefit ratio; (c) to adopt a flexible pattern for integrating the information systems organizations internally in terms of their own departments and functions, and externally in terms of their links with other national, urban and regional, and international data producers and users; (d) to develop technical and financial capabilities and be self-supporting; (e) to devise a workable strategy for ensuring participation of users in project implementation; (f) to upgrade system capability and ensure maintenance and availability of hardware/software systems; and (g) to achieve an effective integration of socioeconomic and natural resources data for planning.

Although progress in the implementation of the information systems has been slow, the planning officials have come to recognize the value of information in planning. They recognize that information systems have an important function to fulfill in urban and regional planning. Thus, information technology represents more than a promise in the three developing countries; increasingly it is used in the areas of information retrieval and geographic and land information systems.

NOTES

1/ As examples, see the United Nations ACC Task Force on Rural Development, *Guiding Principles for the Design and Use of Monitoring and Evaluation in Rural Development Projects and Programmes* (Rome, 1984); United Nations Development Programme, *Evaluation Study Series* (New York, 1980); U.S. Agency for International Development, *A.I.D. Evaluation Handbook* (Washington, DC, 1980); Overseas Development Administration, *A Guide to Project Appraisal in Developing Countries* (London: HMSO, 1972); United Nations Industrial Development Organization, *Guidelines for Project Evaluation* (Vienna, 1972); Harry Hatry et al., *Programme Analysis for State and Local Governments* (Washington, DC: Urban Institute, 1976); Joseph S. Wholey, *Evaluation: Promise and Performance* (Washington, DC: Urban Institute, 1979); Urban Institute and International City Management Association, *Measuring the Effectiveness of Basic Municipal Services: Initial Report* (Washington, DC, 1974); also Urban Institute and International City Management Association, *How Effective Are Your Community Services? Procedures for Monitoring the Effectiveness of Municipal Services* (Washington, DC, 1977); and Organisation for Economic Co-operation and Development, *The Evaluation of the Performance of Computer Systems: A Survey of Policies and Trends in Governmental Computing* (Paris, 1974).

2/ OECD, *The Evaluation of the Performance of Computer Systems.*

3/ ICMA, *Measuring the Effectiveness of Basic Municipal Services*, pp. 33-7.

4/ Ibid., pp.87-98.

5/ Ibid., pp. 113-5.

6/ Helen M. Ingram and Dean E. Mann, "Policy Failure: An Issue Deserving Analysis" in their *Why Policies Succeed or Fail* (Beverly Hills: Sage, 1980), p. 12.

7/ Ibid., pp. 13-6.

8/ See "Information Management" in David C. Slater, *Management of Local Planning* (Washington, DC: ICMA, 1984), p. 209.

9/ Emile G. McAnany, "Success or Failure of Communication Technology in the Third World: By What Criteria Shall We Judge?" (Paper prepared for the Conference on Economic Analysis for Educational Technology Decisions, Dijon, France, 19-23 June 1978).

10/ For references on the case study approach, see Leroy Ford, *Using the Case Study in Teaching and Training* (Nashville; Broadman Press, 1969); and Louis J. Goodman and Ralph Ngatata Love, eds., *Management of Development Projects: An International Case Study Approach* (New York: Pergamon Press, 1979).

CONTRIBUTORS

Ralph Adam
Division of the General Information Programme, United Nations Educational, Scientific and Cultural Organization (UNESCO), 7 Place de Fontenoy, 75700 Paris, France

Arporn Chanchareonsook
Director, City Planning Division, Bangkok Metropolitan Administration (BMA), Dinsor Road, Bangkok 10200, Thailand

Christian P. Averous
Administrator, Environment Directorate, Organisation for Economic Co-operation and Development (OECD), 2 rue Andre Pascal, 75016 Paris, France

Michael Batty
Professor and Head, Department of Town Planning, University of Wales Institute of Science and Technology (UWIST), Aberconway Building, Colum Drive, Cardiff CF1 3EU, Wales, U.K.

Peter Droege
President, Porter and Droege, Incorporated, 4 Harris Avenue, Boston, MA 02130; and East Asian Architecture and Planning Program, Massachusetts Institute of Technology, Room 4-209, Cambridge, MA 02139, U.S.A.

Josefa S. Edralin
Information Systems Planner, United Nations Centre for Regional Development (UNCRD), Nagono 1-47-1, Nakamura-ku, Nagoya 450, Japan

Romeo H. Gecolea
Director, UNDP Asia and Pacific Programme for Development Training and Communication Planning (DTCP), P. O. Box 2-147, 19 Phra Atit Road, Bangkok 10200, Thailand

Sukehiro Gotoh
Director, UNEP-INFOTERA Project, Environmental Information Division, National Institute for Environmental Studies, Onogawa 16-2, Tsukuba 305, Japan

Hideki Kaji
Professor, Institute of Socioeconomic Planning, University of Tsukuba, Ten'nodai 1-1-1, Tsukuba 305, Japan

CONTRIBUTORS

Hidemitsu Kawakami
Professor, Department of Urban Planning, Tokyo University, Hongo 7-3-1, Bunkyo-ku, Tokyo 113, Japan

Richard E. Klosterman
Associate Professor, Department of Urban Studies, University of Akron, Akron, OH 44325, U.S.A.

Ko Kheng Hwa
Director, Integrated Information Systems Department, National Computer Board, NCB Building, 71 Science Park Drive, Singapore 0511, Republic of Singapore

Frank le Clercq
Head, Central Planning Division, Physical Planning Department, City of Amsterdam, 3 Wibautstraat, 1091 GH Amsterdam, Netherlands

Gerard Linden
Associate Professor, Geo Information Systems, International Institute for Aerospace Survey and Earth Sciences (ITC), 350 Boulevard 1945, P. O. Box 6, 7500 AA Enschede, Netherlands

John Lindsay
Principal Lecturer, Faculty of Technology, School of Information Systems, Kingston Polytechnic, Kingston upon Thames, Surrey KT1 2EE; and Director, Computers and Development Planning Course, Development Planning Unit, University College London, 9 Endsleigh Gardens, London WC1H OED, U.K.

Marvin L. Manheim
William A. Patterson Distinguished Professor of Transportation, J. L. Kellogg Graduate School of Management, Department of Civil Engineering, and Transportation Center, Northwestern University, Evanston, IL 60201, U.S.A.

J. H. Oyugi
Public Administration Systems and Training Branch, Development Administration Division, Department of Technical Co-operation for Development, United Nations, New York, NY 10017

John B. Rose
c/o Division of the General Information Programme, United Nations Educational, Scientific and Cultural Organization (UNESCO), 7 Place de Fontenoy, 75700 Paris, France

Jean V. Salmona
Director-General, Centre d'Etudes des Systemes d'Information des Administration (CESIA); and Data for Development International Association, 122 Avenue de Hambourg, Marseille 13008, France

CONTRIBUTORS

Hidehiko Sazanami
Director, United Nations Centre for Regional Development (UNCRD), Nagono 1-47-1, Nakamura-ku, Nagoya 450, Japan

K. V. Sundaram
Consultant, Economic and Social Policy Division, Food and Agriculture Organization of the United Nations (FAO), Via delle Terme di Caracalla, 00100 Rome, Italy

Suroso Moersidi
Head, Remote Sensing Project, Center for Data Processing and Mapping (PUSDATA), Ministry of Public Works, Patimura 20, Kebayoran Baru, Jakarta, Indonesia

Itoko Suzuki
Senior Public Administration Officer, Room DC1-0982, Public Administration Systems and Training Branch, Development Administration Division, Department of Technical Co-operation for Development, United Nations, New York, NY 10017

Moriaki Tsuchiya
Professor of Business Administration, Faculty of Economics, Tokyo University, Hongo 7-3-1, Bunkyo-ku, Tokyo 113, Japan

Sidney W. Witiuk
President, Spatially-Oriented Referencing Systems Association (SORSA), P. O. Box 3825, Station C, Ottawa, Ontario K1Y 4M5, Canada

Yu Hong
Senior Engineer, China Building Technology Development Centre (CBTDC), 19 Che Gong Zhuang Street, Beijing, People's Republic of China

592